FALL MANUAL OF PRACTICE IN ECONOMIC ZOOLOGY

OHIO
Agricultural Experiment Station

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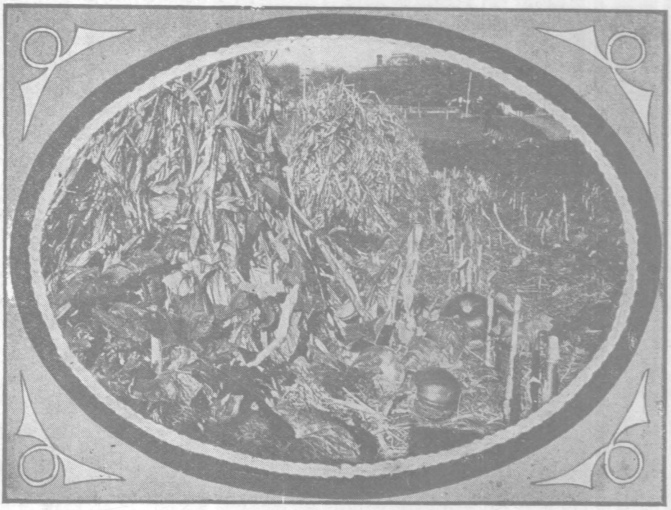

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[1]In cooperation with the College of Agriculture, Ohio State University, Columbus.
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[5]On leave of absence.

BULLETIN

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FALL MANUAL OF PRACTICE IN ECONOMIC ZOOLOGY

By H. A. GOSSARD

INTRODUCTION

The appreciative reception given to the Winter and Spring Manuals of Economic Zoology encourages the author to believe that the general plan of these bulletins is suited to the needs of students of practical entomology. In submitting this, the third number of the series, he bespeaks for it the same kindly attention and the same practical test of usage that was accorded to the earlier numbers.

The reader should understand that the remedies and preventive measures hereinafter indicated are suggestive and not intended as recommendations to be regularly followed every season. The summaries of measures given at the close of each crop section merely indicate the pests against which such procedure will operate, and each farmer must determine for himself whether the conditions prevailing on his farm render advisable the adoption of any of the measures mentioned. In some instances, hardly one of the measures named will be needed, while in others one or more of them are imperatively necessary.

GENERAL PRINCIPLES OF PRACTICE

CLEAN FARMING

Clean cultivation does much toward controlling insect pests. It removes weeds which support thousands of insects and which, in some cases, bridge over vital periods in the lives of very important pests; for instance, if no seed of smartweed, ragweed, purslane, foxtail or other common weeds of the corn field are allowed to mature, there will be no roots of these early spring weeds to sustain the corn root aphis until the corn roots are ready for them. The chinch bug hibernates, as a rule, under weeds in the corn field, or in and around stubble fields. The tarnished plant bug thrives whereever weeds abound. Flea beetles multiply rapidly on the roots of nettles and various other weeds, especially nightshades. The buffalo tree hoppers and the tree crickets multiply far faster and become far more annoying in orchards and fruit gardens if there is a nearby thicket of weeds in which they can find food, shelter and suitable places for depositing their eggs. The common stalk borer lays its eggs largely upon weeds, notably the ragweed. The yellow banded, zebra-like beetle, which is the parent of the locust borer, is more or less dependent on the flowers of the golden rod for its food supply. Make careful and opportune use of the plow, cultivator, disc, common harrow, weeder, mowing machine and scythe to cut off all these common sources of support for such insect foes of the field, orchard, garden and forest. Clean farming also means to pick up boards, limbs, brush, piles of hay, etc. These should be burned or so disposed of that the full value of the rubbish will be conserved without endangering valuable crops, such as may be injured by insects which find shelter beneath it. Keep the weeds down along roadsides and in pastures, against fence rows, and in out of the way corners. The remnants of old crops and volunteer plants should be destroyed as soon as possible after the harvest. Old potato vines afford shelter, over winter, in the stalks, for the potato stalk borer; old asparagus shoots give winter protection to the asparagus beetle; old squash vines contain the pupae of the squash borer; old cabbage stalks sustain the cabbage louse or carry the eggs over winter, etc. Small piles of old grain in corners of the bins and on the ground beneath the floor, where it fell through cracks and knot holes, keep various forms of granary insects breeding throughout the year and hence the new crop is at once attacked as soon as it is stored. Old clover hay in the corner of the mow or under a ladder in some hallway may carry over the clover hay worm and start great mischief in the new crop when it is put away. Keeping the scaly bark

scraped from the trunks of fruit trees will prevent many injurious insects, such as codling worm, pear psylla, woolly aphis, etc., from finding shelter on the trees which they expect to restock with their kind the next spring. There is but little danger of a practical, sensible man becoming over-solicitous about these matters, and the need of giving constant and thorough attention to them can hardly be over-emphasized.

BURNING

The old fashioned practice of burning over the stubble fields in the fall had some commendable features in spite of the fact that much humus was thereby lost to the soil. The general practice of using wheat as a nurse crop for clover has compelled the abandonment of this old custom, and, as a consequence, certain wheat insects, notably the Hessian fly and the wheat jointworm, have become much more abundant and injurious in late years than they formerly were. So serious, indeed, have these pests become that many growers have preferred to use rye or some wide-branching, or loose-headed variety of oats that lets the sunlight through to the ground as a nurse crop for clover, and have discontinued the production of wheat. Burning the wheat stubble would largely control these pests, and with the present great demand for wheat, it is not improbable that agricultural adjustments will be made which will again make possible the burning of wheat stubble in the fall. So large a number of insects shelter in the stubble of different crops and among weeds along the roadside or around the borders of fields, and the eggs of so many of these and of others are laid on weeds and grass, that careful burning in fall or in early spring is, in many cases, a paying proposition, notwithstanding considerable offsetting loss from waste of material that would change into humus. Hessian fly, wheat jointworm, chinch bug, stalk borer, army worm, cutworms and many other insects are greatly diminished by this measure. In some cases, it is advisable to make trap-heaps of rubbish and weeds here and there in the field or garden, beneath which many of the nearby insects will seek shelter. When they are thus congregated under the heap, set it on fire in late fall or in early winter. Trap heaps are specially adapted for use in the garden. As previously suggested, burn all remnants of garden crops as soon as the harvest is finished.

FALL PLOWING

Deep fall plowing is often the best measure that can be taken against field and garden pests. It may be undesirable to fall plow rough, uneven land, and some soils may not yield themselves to this

treatment, but it can be confidently recommended for most fields that are level and which happen to possess the correct degree of moisture. Cutworms, the corn ear-worm, wireworms, white grubs, the wheat midge, grasshopper eggs, the corn root louse, sod web worms and many others are thus destroyed, or their numbers are, at least, thinned out. The later the plowing is done, the more effective it is apt to prove against grubs, wireworms and a few others. If the insects are exposed after they have become torpid and when the weather has become cold, they cannot re-enter the earth and, therefore, they must perish from exposure or else be devoured by their natural enemies Some farmers will prefer deep plowing instead of burning for the destruction of the wheat jointworm, Hessian fly and other insects which have the habit of wintering over in the stubble. Plowing this straw under adds a considerable amount of humus to the soil and buries the insects so deep that they cannot work their way to the surface when they transform in the spring.

Shallow cultivation is useful in fall against some species. The cocoons of the squash-vine borer are brought to the surface by lightly harrowing, and many will be destroyed by natural enemies or die from winter weathering; deep plowing in the spring will complete the work by burying any surviving chrysalids so that but few, if any emerging moths, can reach the surface. Disking in fall, or raking with a long-toothed steel rake has been recommended by some writers as useful to bring to the surface the cocoons of the fall army worm and of the sod web worms. Fall plowing is likely to be most successful against subterranean insects in such countries as are very cold. White grubs and wireworms are not greatly inconvenienced by being brought to the surface at the beginning of ordinary Ohio winters, unless birds, skunks or other natural enemies are abundant in the neighborhood.

ROTATION AND COOPERATION

All crops, whether sown in spring or fall, should fit into a well planned rotation system (See Spring Manual, Page 17). Probably no other measure is at once so practicable and so effective as this for the control of such field pests as the wheat jointworm, corn rootworm, corn root aphis, wheat midge, clover seed midge and many others. The larger the territory included in a single rotation plan, the more effective the measure will prove. Large rotation tracts on a big farm will curb insect multiplication far better than a small-plot rotation system on a small farm, because the insects must fly further to find suitable feeding grounds and there is, therefore, a much

greater chance that they will become lost and perish before having had an opportunity to lay their eggs on their customary food plants. Under present social practices, each farm, whether small or large, is the unit of rotation. However, considering the present tendency for farmers to combine and cooperate together for the purpose of promoting their common welfare, it seems that we have a better foundation than a mere Utopian dream for hoping that at some future time, larger areas, such as whole townships, may be made units of rotation. If such a hope is ever realized, such insects as the Hessian fly, the wheat jointworm, the corn root-worm, the wheat midge and many other common field pests, must of necessity become quite rare, and possibly will be rated as curiosities and prizes for the entomological collector.

NATURAL FRIENDS

During late summer and fall, many birds are most active as insect destroyers. Young birds which are just approaching maturity in early fall are ravenous consumers of grasshoppers, cutworms, caterpillars, etc. Some species, such as the quail, consume large numbers of chinch bugs, also similar small and injurious insects, and weed seeds. Every farmer should see to it that there is no open season at all for the hunting and killing of quail or any other birds on his farm. While some species might be thinned out with profit, it is certain that few, if any hunters, will refrain from shooting valuable birds if they are given permission to shoot any other sort on the farm. The farmer should make a careful study of the known habits of his natural friends and enemies and himself attend to any thinning out that may be needed.

Many species of birds migrate southward in fall. Consult the Winter and Spring Manuals to learn which ones may, by proper inducements, be persuaded to winter over in your neighborhood. The plantings and environments discussed in these publications will have an important influence in determining some of these autumn wanderers whether to remain with you, or to seek, instead, some better neighborhood.

Some of the trees, shrubs and vines which furnish autumn or winter food for birds are these: Choke cherry, black cherry, mountain ash, elderberry, dogwood, sour gum, black alder, wild grape, Virginia creeper, Boston ivy, partridge berry, barberry, pokeweed, sumach, red cedar, juniper, the viburnums, the birches, the conifers and various nut trees. If winter shelter belts look inviting and if a diversified and easily accessible food supply is conjoined therewith, a goodly number of winter residents may be expected to establish their headquarters in the neighborhood, provided they are reasonably free from molestation by enemies.

Sometime during the fall, put up signs, in large letters, over your property, warning off trespassers, and forbidding hunting thereon. Rigidly enforce the notice.

FARM TREATMENT

INSECTS INJURIOUS TO VARIOUS GRASSES AND GRAINS

SEPTEMBER, OCTOBER AND NOVEMBER

Grasshoppers lay their eggs in masses of about 30 in pod-like cavities made about one inch underground. During September and October the females may often be found with their abdomens sunk into the soil and at the bottom of the excavation will be found the clusters of yellow eggs. Compact soil, such as closely grazed pasture land, especially high, bare and sandy ground, also roadsides and the borders of fields are apt to be chosen for incubating purposes. Fall plowing to the depth of eight or nine inches will effectually prevent any of the young hoppers from reaching the surface when they hatch in the spring. Thoroughly disking or harrowing land containing eggs, in late fall, so the surface is well torn up to the depth of an inch or two, will break open most of the egg-nests and prevent hatching.

The **Chinch Bug**, *Blissus leucopterus*, creeps under old boards or rubbish of any kind, during the late days of fall to hibernate during the winter. Grassy borders around old wheat fields and corn fields are specially apt to shelter them. If the rubbish is collected and burned and the borders are burned over, the insects will either be destroyed or else they will be deprived of their winter retreats and exposed to attack by birds and to the killing qualities of winter weather. Millions of them hibernate under shocks of corn fodder. Remove the fodder in early winter and spray the congregated bugs with strong kerosene emulsion.

Wireworms in the soil are very difficult to destroy. Therefore, it is very important to ascertain, if possible, in the fall of the year, whether or not they are present in dangerous numbers in any place upon the farm. They are most apt to be present in land which was recently in sod, but since some species are three years in reaching maturity, they may remain quite abundant in land that has produced two or three cultivated crops since having been in grass. It is best to plow infested land in the fall, since plowing breaks up the pupal cells, thus killing the pupae and preventing their development into beetles which would lay eggs the following year and thus perpetuate the plague. Likewise, the soft beetles which have already transformed from pupae, but which do not leave the pupal cells until

the next spring, are also killed. The pupae and soft young beetles of the majority of species will be destroyed by plowing any time between August 1st and December 1st.

By plowing in August and harrowing at intervals during the following month, wheat or rye may be sown, unless larvae not old enough to pupate remain in the ground in large numbers. If an excessive number of these unchanged larvae remain, it is not advisable to plant the following spring to corn, potatoes or vegetables. Wheat, rye or oats will do fairly well, notwithstanding moderate infestation, but the only crops that can be recommended to make headway against excessive infestation are those of strong, dense growth with thick, hard roots, such as clover and buckwheat.

A regular crop rotation is the best security against depredations by wireworms. Whatever crops are planted on infested land, it is very expedient to fertilize heavily so as to stimulate the crop to outgrow the damage. An abundance of mixed commercial fertilizer, from 600 lbs. to 2,000 lbs. per acre, will enable most crops to do well in spite of the worms, but even one ton per acre of fertilizer, or of common salt, will have but little effect in killing the worms in the soil. Pasturing infested land with hogs in the fall would serve the same purpose as plowing, since both pupae and soft beetles would be killed by the rooting up of the ground, and there would also be the chance that many of the younger worms, as well as pupae and beetles, would be eaten. Birds and domestic poultry, following the plow and harrow or supplementing the work of hogs, would destroy many of the insects. Corn soaked in solutions of arsenic or strychnine (see Spring Manual for recipes for preparation) may be sowed broadcast and harrowed into the soil about two weeks before putting in the crop. The larvae of some species are said to be killed by eating such bait.

White Grubs are controlled, to some extent, by fall plowing. If a severe winter follows after the plowing, the results may be expected to be of some value, but in case of only moderate cold, such as we usually have during Ohio winters, the grubs are apt to survive unharmed. Pasturing with hogs is probably the best method for destroying them on a large scale. Gas lime, applied with a fertilizer drill at the rate of 1,000 lbs. to 3,000 lbs. per acre, is said to have proved valuable in some cases against grubs. It seems to be much more effective against these insects than against wireworms. Only fresh gas lime can be relied on, as an insecticide. Iron oxide from gas factories has not proved especially valuable against white grubs, according to our own experiments in Ohio.

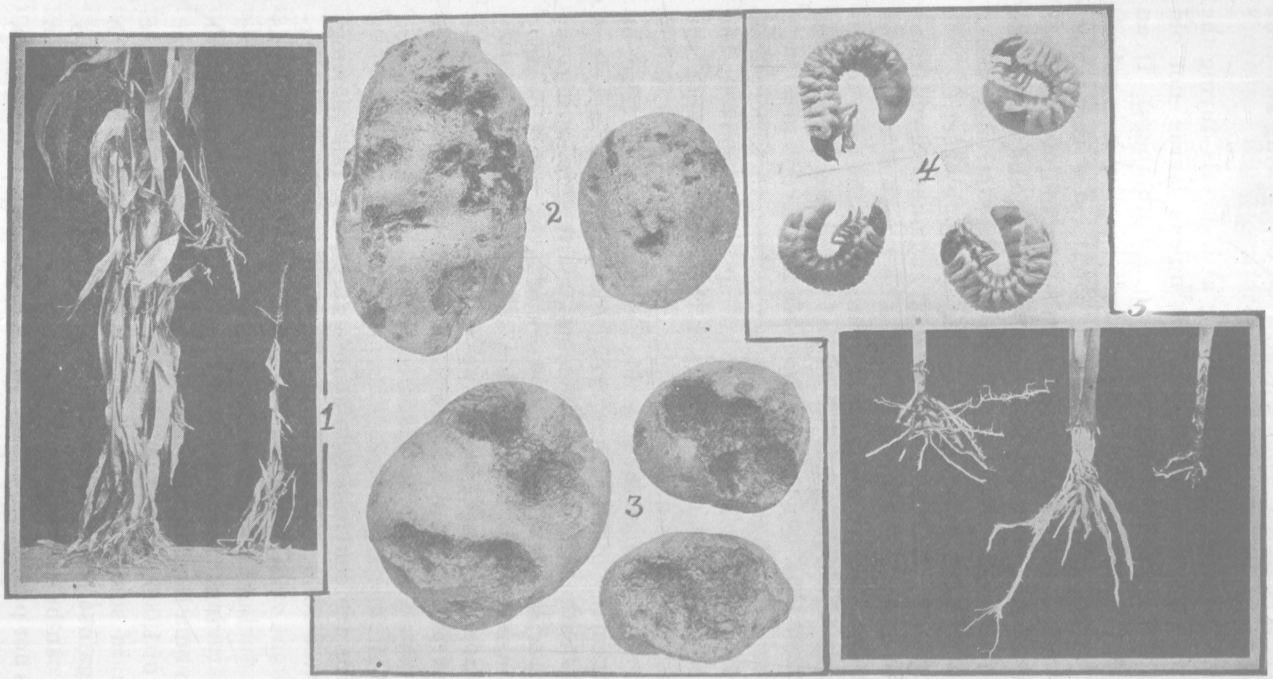


Plate I.

Work of White Grubs, *Lachnosterna* spp. and of the Potato Scab Gnat *Epidapus scabei* (See p. 163).

1. Hill of corn not injured by grubs contrasted with a nearby hill ruined by them.
2. Two potato tubers injured by the maggots of the Potato Scab Gnat.
3. Three potato tubers damaged by White Grubs.
4. White Grubs or larvae of the June or May Beetles.
5. Roots of corn eaten off by White Grubs.

Cross plowing and disking are valuable measures to add to fall plowing as a measure against grubs. Late summer and fall fallowing of infested land is recommended as worth while in some cases. Keep the ground free from weeds while letting it lie fallow. Rotation of crops is exceedingly important as a means of avoiding injury by grubs. They are always apt to be worse following grass and pasture. Corn, potatoes, vegetables and strawberries are among the crops that are most likely to suffer from their presence. The cereal grains also suffer, and sometimes are greatly damaged, but being thicker on the ground than the crops just named, are better suited to withstand a moderate degree of infestation. Clover and buckwheat are about the only crops that can be advised when infestation is excessive.

Cutworms are the larvae of various species of medium sized, sober-colored moths and become most abundant on grass land or on land that has growing upon it a heavy covering of succulent vegetation of almost any kind. In the case of many species, the eggs are laid in the fall. A field that is known to be badly infested may be plowed in the early fall. This will prevent additional egg-laying on the land by the later appearing moths, and caterpillars which have already hatched will be compelled to find a richer feeding ground elsewhere or starve. Sufficient cultivation should be given during the fall to prevent the growth of weeds.

The half-grown caterpillars of the **Army Worm**, *Heliophila unipuncta*, hibernate over winter in grass land, in stubble fields, among weeds, and under trash of various sorts. Burning over the infested area in fall will destroy many of them. If it is desired to utilize the stubble and other growth for the production of humus, as is generally advisable, fall plowing to a moderate depth, will effectually bury most of them. "A stitch in time" is very important in case of this insect. The general color of the army worm when half-grown is obscure greenish to very dark, with dusky longitudinal stripes, alternating with pale ones.

The **Fall Army Worm**, *Laphygma frugiperda*, resembles the true army worm in general appearance, but their life histories are different in the respect that the last brood of larvae of the fall species matures before winter and the worms enter the soil and pass into the chrysalis stage. While the army worm confines its feeding largely to grasses and cereals, the fall army worm is a much more general feeder, and all kinds of vegetables and garden truck, besides alfalfa, millet and the grasses and cereals, are laid under heavy tribute. Deep fall plowing and harrowing will break up the pupal cells and prevent the development and emergence of the moths. A

heavy roller can be run over lawns and fields planted to young grain, thus crushing many of the worms. Sometimes it is advisable to pasture cattle or sheep on infested fields, thus insuring the death of many larvae from trampling. In many cases, it is best to spray the feeding grounds of the worms with an arsenical poison or, over small areas, the poisoned bran bait recommended against cutworms may be used (See Spring Manual, p. 78). Clean cultural methods and rotation of crops will go far toward rendering other measures unnecessary in case of both species of army worm. The true army worm does not appear in excessive numbers after early August while the fall species does not appear in great numbers until much later. The fall species has a white, y-shaped mark on the front of the head, which is wanting in the true army worm. The fall worm is also the smaller of the two.

The Stalk Borer or Heart Worm, *Papaipema nitela*, is found in May, June and July occupying the interior of stalks of corn, oats, wheat, barley, tomatoes, potatoes and various garden flowers. It seems able to thrive on almost any plant that has a stalk of convenient diameter to enclose it. It is a light brown caterpillar with a continuous white stripe down the middle of the back and two broken or interrupted white stripes on each side. The break in the side stripes begins with the first abdominal segment, just behind the last pair of true legs and extends over four segments. These spring larvae mature during July and August. They pupate largely in their burrows, where they remain until they issue as moths during late August, September and part of October. The moth is fawn-gray or mouse colored, with the outer third of the wings lighter and bordered within by a narrow, white cross-line. The eggs are said to be laid in September and October on the stalks of plants, near the ground. These eggs do not hatch until the following spring. Ragweed, burdock, and various other weeds of similar character are doubtless utilized as food plants, hence the destruction of all such weeds in the fall is important. Thorough destruction of weeds, corn stubble, etc., in the fall would, in all probability, greatly lessen injury by destroying the eggs. Since the eggs are laid very close to the ground, the stubs, as well as the stalks, must be annihilated.

WHEAT INSECTS

SEPTEMBER--OCTOBER

The second brood of Hessian fly, *Mayetiola destructor*, appears early in September over northern Ohio, the very earliest specimens coming in August. The bulk of the flies are on the wing during the

last half of September at Wooster, for the most part during the last ten days of September, and egg-laying extends into October. In central Ohio, the insects appear about one week later than the dates indicated, and in southern Ohio, about two weeks later. During the greater majority of seasons, parasites practically control this insect, and the most economical policy during such years is to sow on the date which experience has determined as the best for each locality, without giving special consideration to the question of fly infestation. The wheat midge and danger of winter killing, each constitutes a menace to late sown wheat which must not be forgotten. During the seven years in which the writer has resided in Ohio, the farmers who have sown their wheat from the 15th to the 25th of September, in the northern part of the state, have harvested better crops, on the average, than those who sowed from ten days to two weeks later, notwithstanding the fact that this early sown wheat was up and subject to attack by the fly during its busiest period of egg-laying. The aggregate loss the state would suffer through a period of twenty years of late sowing (by late sowing, I mean a date sufficiently late to insure that the flies will have disappeared by the time the young wheat is suitably grown to invite the deposition of Hessian fly eggs) will, in my opinion, more than counterbalance the loss the fly is likely to inflict during the same period, even if its presence is wholly ignored. In making this estimate, I am not losing sight of the fact that it is very probable that in every 20-year period, Hessian fly will reduce the crop to less than one-half an average yield during one, and possibly two seasons, if no attention is given to it. The best that can be done under such conditions is to adhere quite closely to the dates for seeding which experience has shown to give best results under normal conditions, and to depart therefrom only when the balance of probabilities indicates special danger which may likely be avoided by deviating from such dates. After an unusual outbreak of the fly, covering a period of one to three seasons, an abundance of parasites may be presumed as soon as the virulence of the outbreak is manifestly subsiding. Under such conditions, I believe it is best to sow at the normal date, choosing for seed the screened product of a variety possessing a large or medium straw, but above all, with excellent stooling qualities. Before seeding, the ground should be harrowed and rolled and re-harrowed and rolled again as often as necessary to give a pulverized and compact bed in which the plants can start. The addition of fertilizer to the soil will quicken growth, encourage prolific stooling, develop a strong straw and do much toward carrying the field successfully through any moderate attack. Perhaps a formula calling for three or four per-cent of ammonia, eight to ten percent of phosphoric acid, and two to

three percent of potash, and applied at the rate of 300 pounds or more per acre will be about right for the average Ohio farm. Sow as far away from old stubble as possible and burn badly infested stubble whenever possible. Stubble should be burned before the first of September, if at all. If the stubble is carefully and deeply plowed under so that all of it is covered, the result should be about as satisfactory as if it were burned, so far as extermination of the flies is concerned, and a valuable amount of humus will be saved to the soil.

The years in which late seeding is to be recommended, are usually those coming after a lapse of several years since any bad outbreak of the Hessian fly. The parasites which became abundant in the years immediately after the irruption and which made early sowing safe for a period of years, will have become thinned out, owing to their own work in nearly exterminating their food supply, or to weather conditions, or to the effects of secondary parasites (parasites which devour the parasites that feed upon the fly), or to similar causes, giving to the Hessian fly a free field in which to increase without retardation. Unfortunately, it is sometimes impossible, even for a professional entomologist, to recognize the approach of these unfavorable conditions and the outbreak is quite apt to come as a complete surprise to everybody. If, however, there are plain indications of an incipient outbreak, which the farmer discovers for himself, or of which he has been warned by entomologists familiar with his territory, he should, by all means, sow a week or ten days later than the normal date, especially so if the season has been abnormally dry so as to retard the appearance of the adult flies. A later date than the one suggested invites too great danger of winter killing of the wheat, and while this recommendation may not put the crop sufficiently late to escape the reception of a big fraction of the egg-deposit, there is good reason for believing that only a small proportion of the larvae hatched from these late laid eggs survive the winter; therefore, the safety of the crop, under these threatening conditions, is best insured by sowing neither much earlier nor much later than as above suggested.

The accompanying map (p. 65) is suggested by Prof. C. G. Williams, of the Agronomy Department, as showing approximately the normal dates for sowing wheat in the different sections of the state.

The Wheat Jointworm, *Isosoma tritici*, appears as a four-winged, wasp-like adult in late May or early June, but some important preventive measures may be taken in the fall. The insects are in the larval stage, chiefly in old stubble fields and in strawstacks, at seeding time. Hardened, woody places in the straw which is contorted, bent, and covered with small knots at the hardened locations, indicate

the probabilities of jointworm larvae being imprisoned within. It is desirable to sow as far as possible from old stubble fields known to be badly infested, and to burn over infested stubble where possible. Where the wheat has been used as a nurse crop for clover, it is usually impracticable to burn over the stubble in the fall. Such burning would best be postponed until winter or spring, when the clover is frozen down, and then it may be done with comparatively little damage to the clover. If the stubble is thin, it may be harrowed down and then burned with greater success, or if too thin to burn in this way, it may be harrowed down and then raked into windrows or heaps and set on fire.

Normal dates for sowing wheat in Ohio.

Deep plowing of infested stubble fields would seem to promise as good results as burning and a valuable amount of humus can thus be saved to the soil.

Sow a variety of wheat which is known to succeed well locally, preferably an early maturing, stiff, large-strawed kind. Fertilize liberally, using about the same formula as recommended in the Hessian fly section (See pp. 63-64). Also give careful attention to the preparation of the seed bed and sow as near the normal date as possible (See p. 65).

It is sometimes advisable to sow rye instead of wheat in badly infested districts to fill in the scheme of crop rotation. Rye is attacked but slightly, probably not at all, by this species, and other jointworms do not trouble it seriously. Barley may be used instead of rye. The wheat jointworm does not attack barley, so far as known, although a different species of jointworm damages it very much. Barley is usually sown in the spring in Ohio.

The **Wheat Straw worm**, *Isosoma grande*, has a life history somewhat different from the jointworm but the character of damage to the straw is similar. The straw worm causes a slight enlargement to develop in the straw, just above some node, and inside this the larva is located. Ordinarily, there is no gall and comparatively little thickening of the straw walls.

It is fortunate that the winged females of the straw worm are of small size and incapable of prolonged flight, and furthermore that most of those which issue in spring are wingless and unable to travel far. Rotation of crops is, therefore, an entirely satisfactory remedy for this insect. If, at any time, they appear in considerable numbers, sow wheat at a considerable distance from stubble fields of the preceding crop. Since the insects are carried over winter as pupae both in the old stubble and in the straw, such infested material should be burned, if at all possible, during fall or winter. The observations regarding burning of stubble to destroy the jointworm apply here equally well (See p. 65). There is an early spring brood of adults, coming in April, and a later brood which appears in May and June.

The **Wheat Midge**, *Contarinia tritici*, commonly called the "red weevil" is a very small, delicate fly which appears on the wing sometime in June, usually about the date when the fireflies first appear and the blossoms of the locust trees are fading and falling to the ground. The eggs are laid in a cavity or groove at the upper end of the outermost chaff, so that the young maggots, on hatching, can readily reach the incipient kernel. These reddish larvae imbibe nourishment from the milky kernel, ceasing to feed after the grain becomes hard. When full grown they seek the earth, generally by crawling down the stalk when it is wet with dew or by sliding down in a raindrop. Going about one-half an inch beneath the surface,

they make cocoons not larger than mustard seeds, very difficult to find, in which they remain until the following summer when they again issue as flies. However, many of the larvae have not left the heads by harvest time and these are carried into the barn or stack; they soon become dry and shrink away from their skins, becoming "cased larvae;" these do not feed; they again become active when thoroughly moistened, even after having lain quiescent for more than half a year. Since the chaff from the threshing machine contains countless numbers of these "cased larvae," it should be promptly burned; the bulk of the straw can be put to its customary use without special danger. All seed wheat should be well fanned or screened to prevent sowing midge larvae along with the seed. The screenings should be burned.

The great majority of the midge flies are always derived from the pupae buried in old wheat fields. Rotation of crops will be of some help in controlling them, many of the flies becoming lost and perishing while hunting new fields in which to lay their eggs. However, the only thorough remedy is to plow the stubble under in the fall or early spring to such a depth that the flies cannot make their way to the surface the next year. This is best done as soon after harvest as possible. Plowing to a depth of 8 or 9 inches is sufficient. Burning the stubble before plowing will help. Early varieties suffer less than late, and wheat sown at the normal seeding date suffers less than that sown late. Neighborhood cooperation in all these remedial measures is important.

The **Wheat-head Army-worm**, *Heliophila albilinea*, attracts most attention about harvest time, at which period the worms, which quite closely resemble the true army worms, attack the wheat heads and a single caterpillar may destroy many heads. Rye, timothy and other grains and grasses may be attacked in the same way The heads become ragged and the ground is littered over with fallen chaff and with the kernels, either partially eaten or whole. A second brood of moths appears in July and a new brood of worms comes on in August. These caterpillars descend slightly beneath the surface of the ground and become chrysalids in September. Should they appear in late summer or in early fall and inflict damage after the manner of the true army worm, one should resort to the methods recommended in the Summer Manual for the control of the latter insect; also see page 61. Fall plowing will destroy many of the chrysalids and expose them to the effects of weathering.

The **Meadow-Maggots** or **Leather-jackets** are the larvae of the **Crane flies**, insects which quite resemble huge mosquitoes. The

maggots are usually considered by the farmer to be a pecular kind of "cutworm" or "wireworm." They are about an inch long when full fed, of a dirty-grayish color, and have a tough leathery skin. They are without legs, but at their enlarged posterior end they have some fleshy appendages and a pair of small, horny hooks. They sometimes occur in immense numbers and attack the roots of many kinds of grass, forage plants and grain. So long as they occur in moderate numbers only, they feed chiefly on dead vegetable matter and cause but little loss, but when numerous, entire fields of valuable grass or grain may be destroyed by them. Eggs for the fall broods are laid in September by the species most commonly occurring. Injury to wheat land may be prevented by plowing in early September. When occuring in clover, timothy or grasses, many may be destroyed by slowly driving large herds of hogs, cattle or sheep over the land. The sharp hoofs of the animals, cutting into the soil, crush and destroy many of the worms.

The **Wheat Sawfly Borer**, *Cephus pygmaeus*, tunnels in the stalk making some discoloration just below the injured joints. Inside the straw is a cream-colored worm varying in size from one-fifth to one-half inch in length. By harvest time, nearly all of the joints will have been bored except some of the lowest ones, and most of the larvae will have entered the roots. When the borer has reached the lowest point possible, a circular cut is made around the inside circumference of the straw about one-half inch above the ground. At a later time the straw breaks at this point and only the stub remains standing. Immediately after making the cut, the borer fills the cavity of the straw just beneath the cut with a plug of borings, and then retires into the lower part of its excavation, where it makes a fine silken cocoon within which it spends the winter. It changes to a pupa in March or April and the adult, a four-winged, hymenopterous fly, appears in May. Burning the stubble in the fall will destroy the larvae, or plowing them under to a depth of six or eight inches will accomplish the same result. Most of the recommendations that apply to the control of the wheat jointworm (p. 64) are also applicable to this insect.

There are also other species of sawflies which feed on wheat, such as *Dolerus collaris*, *Dolerus arvensis* and *Pachynematus extensicornis*, all of which are controlled, to some extent, by deep fall plowing. The larvae of these bury themselves in shallow earth and construct silken cocoons in which to spend the winter. If they are turned under by the plow so deeply that the adults cannot escape from the earth in spring, the multiplication of the insects will be much restricted.

Other insects which attack wheat are these:

GRASSHOPPERS. See page 58.
CHINCH BUG, *Blissus leucopterus*. See page 58.
WIREWORMS. See page 58.
WHITE GRUBS. See page 59.
ARMY WORM, *Heliophila unipuncta*. See page 61.
FALL ARMY WORM, *Laphygma frugiperda*. See page 61.
STALK BORER or HEART WORM, *Papaipema nitela*. See page 62.

SUMMARY OF REMEDIES AGAINST WHEAT INSECTS

1. **Burning of old wheat stubble in fall** will be of service against the following insects which attack wheat:

HESSIAN FLY, *Mayetiola destructor*.
WHEAT JOINTWORM, *Isosoma tritici*.
WHEAT STRAW WORM, *Isosoma grande*.
WHEAT SAWFLY BORER, *Cephus pygmaeus*.
CHINCH BUG, *Blissus leucopterus*.
ARMY WORM, *Heliophila unipuncta*.
STALK BORER, *Papaipema nitela*.

2. **Fall plowing** will be serviceable against these:

HESSIAN FLY, *Mayetiola destructor*.
WHEAT JOINTWORM, *Isosoma tritici*.
WHEAT STRAW WORM, *Isosoma grande*.
WHEAT SAWFLY BORER, *Cephus pygmaeus*.
WHEAT SAWFLIES, *Dolerus* spp., *Pachynematus extensicornis*, etc.
WHEAT MIDGE, *Contarinia tritici*.
STALK BORER, *Papaipema nitela*.
FALL ARMY WORM, *Laphygma frugiperda*.
ARMY WORM, *Heliophila unipuncta*.
WHEAT-HEAD ARMY-WORM, *Heliophila abilinea*.
WHITE GRUBS.
WIREWORMS.
MEADOW MAGGOTS or LEATHER JACKETS.
CUTWORMS.
GRASSHOPPERS.

3. **Seeding at the normal date in fall with an early maturing variety** is of more or less value against these:

WHEAT JOINTWORM, *Isosoma tritici*.
WHEAT STRAW WORM, *Isosoma grande*.
WHEAT MIDGE, *Contarinia tritici*.

4. **Moderately late seeding** is, under some circumstances, advisable as a means of preventing egg-laying by:

HESSIAN FLY, *Mayetiola destructor.*

5. **Rotation of crops, through tillage and a liberal use of fertilizers, both of barnyard manure and of commercial mixtures, are very important against all of these insects.**

INSECTS AFFECTING OATS

The following insects, already referred to in preceding pages, are sometimes found attacking oats. The remedies previously suggested should be consulted:

GRASSHOPPERS. See page 58.
CHINCH BUG. (Damage to oats is slight). See page 58.
WIREWORMS. See page 58.
WHITE GRUBS. See page 59.
CUTWORMS. See page 61.
ARMY WORM, *Heliophila unipuncta.* See page 61.
FALL ARMY WORM, *Laphygma frugiperda.* See page 61.
STALK BORER, *Papaipema nitela.* See page 62.
MEADOW MAGGOTS or LEATHER JACKETS. See page 67.

INSECTS WHICH ATTACK BARLEY

The list is very much the same as for wheat. **Hessian Fly** (See p. 62) does not attack barley quite so seriously as it does wheat. Replacing the wheat jointworm, we have the **Barley Jointworm,** *Isosoma hordei.* This larva, in many cases, gives no indication of its presence in the straw, except a slight external discoloration and, again, as many as a dozen galls, each containing one of the larvae, are gathered together in one cluster. Sometimes the collection of galls simulates the appearance of black knot on the plum. Woody sections of straw break away in threshing and separate out with the grain, as is the case with the wheat jointworm. There is but one brood per year, the adults laying their eggs in late May or early June. It seems probable that the measures recommended against the wheat jointworm are all more or less useful against the barley jointworm, but not all of them have been tested against it. Since the larvae are carried over in the stubble and in the straw, burning of the same in fall, or plowing the stubble under are certainly advisable where practicable. Since this insect also lives in wild rye grass, and possibly in other growths, it is important to burn the dead growth along roadsides and around the margins of fields, if infestation is suspected. Barley is generally sown in the spring in Ohio. Besides most of the wheat insects, the list of those affecting oats should be added hereto. See top of page.

INSECTS ATTACKING RYE

The **Hessian Fly** attacks rye, but not so seriously as it does wheat. The remarks on this insect in the wheat section should be read (See p. 62). The **Chinch Bug** (See p. 58) also is not so serious an enemy to rye as to wheat. Rye is sometimes attacked by **jointworms**, closely related to those species which attack wheat and barley, but it seldom suffers seriously. In neighborhoods where the wheat jointworm has become very bad, it is sometimes advisable to use rye instead of wheat to fill in the scheme of crop rotation.

Other insects attacking rye are about the same as those given in the list which attacks oats (See p. 70).

INSECTS INJURIOUS TO CORN

The **Corn Root Aphis**, *Aphis maidi-radicus*, causes the corn to become stunted in growth, the leaves to turn reddish or yellowish in color, and the whole plant exhibits symptoms of weakness. Other insects, such as white grubs and the grass root louse may cause precisely the same symptoms. Only an examination of the roots will determine whether or not the trouble is caused by insects, and if so, what ones are responsible for the mischief. The corn root aphis is bluish-green in color with a white bloom over its body, while the grass root louse is whitish in color with blackish head and markings. Also the corn root aphis has two short slender honey tubes projecting upward from the back part of the abdomen, while in the grass louse, the honey tubes are wanting, but are represented by two slight, brownish tubercles with openings in the center. Besides the roots of corn, the corn root aphis feeds upon the roots of cotton, smartweed, purslane, ragweed, foxtail and crab grasses. The common field ants, *Lasius niger* and *L. alienus*, collect the shining black eggs of the aphids into their nests in the fall of the year and care for them during the winter. On warm days in winter, the ants carry the eggs up to the surface soil and, in cold weather, take them into their deeper chambers below the frost line, so careful are they to prevent damage to them through exposure to changing temperatures. With the appearance of young smartweed plants in spring, the ants carry the young aphids, which are just then hatching, to the roots of the smartweed where they multiply until the corn roots are ready to sustain them. Rotation of crops will do much to prevent injury, and liberal fertilization of the land on which the corn is grown will do much to enable the plants to outgrow damage. Deep fall plowing and disking or harrowing thoroughly, the latter operation repeated a few times during the fall with a

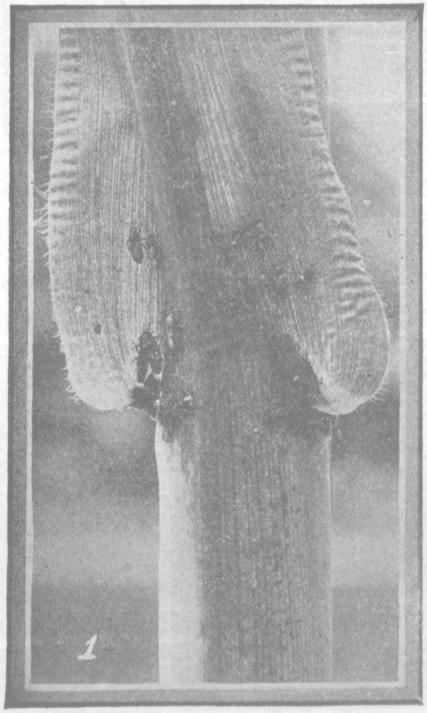
short interval between treatments, will break up the ants nests and keep them broken up, thus exposing the aphis eggs to the vicissitudes of winter. The few that hatch in spring will, in all likelihood, perish because not colonized on proper food plants by ants. Any measures that will prevent the growth of weeds and the maturing of weed seeds in the fall will limit the multiplications of aphis during the following season. Hand cultivation, in the fall, of low spots in the field, after the corn is too tall to plow with horses, is often good and an economical measure. These low spots grow the most weeds and in such places damage by the corn root aphis is always worst.

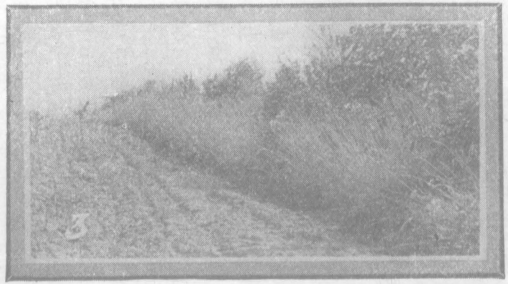
The Boll Worm or Corn Ear-Worm, *Heliothis obsoleta*, is a serious pest of field corn and takes rank as our worst insect pest of sweet or sugar corn. It is known as the **Boll Worm** from its habit of entering the bolls of cotton in the Southern states; also as the **Tomato Fruit Worm** because it burrows into ripening tomatoes, and likewise as the **Tobacco Budworm** because it devours the unfolding terminal buds of growing tobacco plants. It will likewise eat the unfolding bud of the corn plant, and in the southern states, especially, it does much damage in this way. It has a great variety of food plants upon which it can subsist, but in the latter part of the season it largely confines itself to corn in the ear, this being its preferred food. So far as known, there are only two broods per year of this insect in Ohio, though there may be three in the southern part of the state. Since the pupae lie in the ground over winter, several inches below the surface, deep fall plowing will break up the pupal cells and kill many of them.

Ears of sugar corn or of prize corn can be protected by covering them with paper bags, such as are used by grocers. Obtain rather long, narrow bags and in the evening sprinkle them lightly with linseed oil and pack together, laying them with sides against each other. By morning, the oil will have spread all through the paper walls of the bags, and they will thus be able to stand an entire season's weathering, or, with care, may be used through two successive seasons. Fasten the bags rather loosely about the base of the ear and around the stalk with strips of old muslin or calico. Such strings will expand as the ear grows and will not girdle either stalk or ear. The bags should be put in place soon after the silk has appeared, but not until fertilization has been accomplished. Fertilization of all the silks should be completed within a week or less after the first ones appear. It generally occurs the first day that the silk is exposed. When covering, cut away any eggs noticed adhering to the silk.

The **Corn-root Webworms**, *Crambus luteolellus* and *C. caliginosellus** are naturally grass-feeders and become destructive to corn that is planted on newly turned sod. So long as grass covers the ground, the worms attract but little attention and the rapidly stooling bunches of grass quickly repair the damage done. But as soon as the numerous worms are obliged to concentrate on the scattered plants of corn, they make their presence manifest very quickly. The damaged plants stop growing and begin to die. Several caterpillars are often found at the base of a single plant. Each larva is enclosed in a fine, loose web to which adhere fine particles of earth, forming a case, inside of which most of the body of the caterpillar lies, except when it protrudes itself to feed. These depredators sometimes compel several plantings of corn before a stand is obtained and thus make a late crop inevitable. The moth is a light yellowish insect, with brown lines and markings on the wings which are folded around the body in the form of a rounded cylinder when the insect is at rest. The eggs for the second or fall brood of worms are laid in August and September and hatch in a week or ten days. The larval cocoon or web is made slightly beneath the surface of the soil, and the caterpillars become partially grown by winter. There are a number of closely related species, all with habits quite like those which belong to the species just described, and similar remedies apply to all. If these insects are known to be present in large numbers, dismiss the idea of planting corn, and plan instead to plant potatoes, some other root crop, or clover, soy beans or other heavy foliaged crop that can stand heavy injury. One must also consider the probable damage that will be inflicted by white grubs (See p. 59) and wireworms (See p. 58) on any crop selected for growing on sod land. If sod be turned late in the fall, and it is then harrowed at intervals to expose the webworm larvae to the winter weather, danger of injury the following season will be considerably minimized. Very deep fall plowing might prove useful in many cases, since it would seem to be possible to bury the worms so deep that they would be unable to again work their way to the surface. If the land can be plowed in early autumn, before the eggs are laid, such areas will be uninfested the following season because the moths do not lay their eggs on plowed land, and if they should be laid before plowing, the young, upon hatching, will not readily find any vegetation upon which they can subsist.

*According to Dr. S. A. Forbes, *Crambus luteolellus* and *C. caliginosellus* are probably identical, being at most only varieties of one specific form. Twenty-third Annual Report, State Entomologist of Ill. (See p. 155).





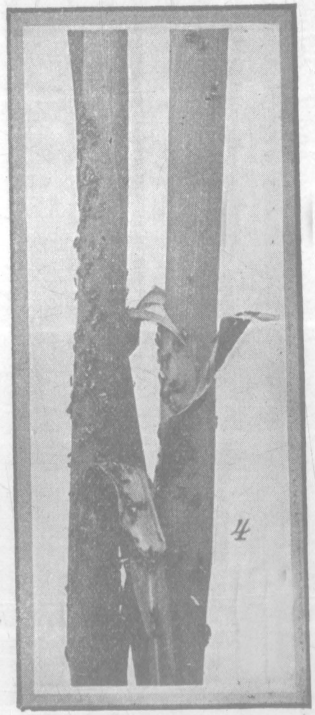


Plate II.

Chinch Bug, *Blissus leucopterus*

1. Immature bugs at base of corn blade.
2. Final moult of insect; adult emerging from pupal skin.
3. Where the bugs delight to hide in winter; along an old-fashioned worm-fence row.
4. Insects densely clustered on corn stalks.

The beetle of the **Corn Root Worm**, *Diabrotica longicornis*, lays its eggs a few inches beneath the soil during late summer and fall where they remain until the following summer. The beetle is greenish in color and about one-fourth inch long. The larvae subsist chiefly on the roots of corn. A simple crop rotation is the best security against injury. It is well, however, to keep a lookout during the fall and ascertain if there are spots in clover fields where weeds have grown up that attract the beetles in unusual numbers. Such areas should not be planted to corn the next spring.

The **Chinch Bug**, *Blissus leucopterus*, is often injurious to corn in the fall, having migrated from grain fields to corn just after harvest. For methods of preventing such migration, see the Summer Manual or Circular 115 of the Ohio Station. After the insects have become well distributed through the corn, but little can be done to ameliorate their mischief. If they congregate in numbers on the bases of the stalks, it often pays to spray with kerosene emulsion, diluted with 12 to 15 parts of water. This may be applied with a spray pump, or in case of need, with a broom. Do not use enough of the spray to saturate the ground about the roots of the corn. Apply in the afternoons of bright, sunshiny days in dry weather, preferably with a breeze blowing, so as to hasten evaporation. While foxtail, crabgrass and other weeds are generally undesirable in a corn field, they are possibly of value in a corn field that has been invaded by chinch bugs, since the insects are quite certain to abandon the corn and establish themselves on the grass and weeds. Shocks of corn fodder are utilized in the fall as a hiding place by the bugs and millions of them may sometimes be found in the base of a single shock. Where they have thus collected, it is advisable to take a loaded spray wagon to the field, when hauling the fodder, and spray the butts of the stalks with kerosene emulsion as these become exposed in loading. Also spray very thoroughly the spot on which the shock stood. This will do something to curtail the multiplication of the pest the following season. See p. 58 for further advice.

Quite frequently during September, we find a stout, brownish beetle wedging its way under the husks of corn ears which are in the milk, and cleaning off the soft kernels down to the cob. This insect is from one-half to five-eighths, or more, of an inch long and is provided with an abundance of soft, yellow hairs, quite like those on a bumble bee. The light brown wing-covers and thorax are thickly spotted over with black dots, splotches and irregular lines. The legs and some other parts of the body have a metallic, coppery iridescence in some lights. This is the **Bumble Flower Beetle or Brown Fruit Chafer**, *Euphoria inda*. It is specially partial to sweet

corn and popcorn. The beetles often feed on the sap exuding from trees and on the juice of over-ripe or injured fruits. The larva is a large, white grub, often found in numbers in heaps of manure and decaying vegetable humus. The beetles hibernate over winter and lay their eggs in April and May. The new brood appears in late August. Hand picking is probably the most reliable remedy. Possibly some could be killed by dusting the silks of corn ears with Paris green or with powdered arsenate of lead. Extreme care would need to be taken if these poisons were used on corn nearly ready for table consumption. Corn ears treated thus would need to be thoroughly cleaned of all silk and well washed before being cooked. Specially valuable ears may be protected by tying paper bags over the tips of the ears (See page 72).

Consult these pages, as designated, for information regarding insects already treated and which also attack corn:

GRASSHOPPERS, page 58.
CUTWORMS, page 61.
WIREWORMS, page 58.
WHITE GRUBS, page 59.
ARMY WORM, *Heliophila unipuncta*, page 61.
FALL ARMY WORM, *Laphygma frugiperda*, page 61.
STALK BORER, *Papaipema nitela*, page 62.
WHEAT-HEAD ARMY WORM, *Heliophila albilinea*, page 67.

SUMMARY OF REMEDIES

1. Late fall plowing is of more or less utility against all of the insects herein mentioned as affecting corn.

2. Early fall plowing is perhaps more effective than late against the webworms.

3. Spraying and burning are useful against the chinch bug, the army worm, and in less degree, the stalk borer.

CLOVER AND ALFALFA INSECTS

Occasionally, threshed clover seed contains a great number of the pinkish or yellowish pink larvae of the Clover Seed Midge, *Dasyneura leguminicola*. These larvae, if very abundant in the seed, should be killed by drying them out with gentle heat so as to prevent any possibility of their again becoming active when buried in the soil at seeding time, and also to prevent heating of the seed in storage because of the presence of so much animal matter. Seed of any sort, heated in storage, is apt to encourage the presence and multiplication of various species of grain insects. The larvae of this midge leave the heads of their own accord, when they are full fed, and descend to the ground, where they construct small, tough,

papery cocoons just under the surface. They remain in this situation over winter, appearing as minute flies the next spring. Plowing second year clover late in the fall or early in the spring buries the insects so deep that it seems likely that few, if any, ever work their way through the soil to the top.

Often at threshing time, much of the clover seed is eaten out inside, only a thin shell remaining. Such seeds are generally of a dull, brown color, misshapen and undersized. Inside of such seeds will be found the pupae, larvae, or adults of small, blackish, four-winged flies. This species is the **Clover Seed Chalcid,** *Brucophagus funebris.* The flies will have left some of the seeds by threshing time so that only light shells remain, which are blown away with the chaff. Thus, a very light yield is sometimes obtained when the farmer is expecting a good one. Most of the seeds which still contain insects at threshing time, pass to the granary, and the adult flies may emerge in the bins in very great numbers. Fortunately, so far as known and believed, this insect cannot propagate in dry seed, and such adults as issue in the granary must perish unless they find some way to escape from the bin to the field. It is important to keep down all clover heads around the borders of fields and also all volunteer clover on which these insects can lay their eggs in fall. The red and crimson clover are favorite food plants, but alfalfa and mammoth clover are attacked in lesser degree. Since most of the adults appearing in spring come from seed that has dropped to the ground, and in which the insects have remained over winter, plowing of clover stubble in late fall or early spring should bury them beyond the possibility of emergence. In districts where the insect is prevalent, the heads of first year clover should be clipped as soon as they are well developed to prevent these from carrying the insect over until the next year.

Throughout most of the month of September, a small moth, generally in sparse numbers but sometimes very numerously, may be seen flying over clover fields. The color of the moth is dark silky brown. When the wings are closed, two silvery white, parallel crescents spread transversely across the back. There are also eight or nine silvery white bars or streaks arranged along the front border of each fore wing. There are also some patches of iridescent scales on the fore wings. The wing expanse of the moth is about one-third of an inch or a little more. The caterpillar of this moth is known as the **Clover Seed Caterpillar,** *Enarmonia interstinctana* (*Grapholitha interstinctana.*) The caterpillars injure the seed crop by devouring the young, developing florets. A single caterpillar can soon practically destroy an entire head. The eggs

of the fall or September brood of moths are laid in belated and immature heads, or at the crowns of the plants. The caterpillars feed during September and October in the heads and in the crowns. Some of these pupate before winter, but of those feeding in the crown, many remain as larvae over winter and resume feeding in early spring. First year clover, if infested, may be pastured in the fall. Old clover can be plowed under in the fall and the land can be harrowed and rolled. Since the larvae seem to survive the winter much better where there is abundant trash on the ground, heavy manuring of clover fields that are not to be plowed under, should not be encouraged during years when this insect is causing notable injury.

The **Clover or Pea Louse**, *Macrosiphum pisi*, sometimes becomes very destructive in May and June, thereby causing the death of clover following the early cutting and thus causing the loss of the second crop. These spring lice are the progeny of a comparatively few females that winter over and of a few eggs that are laid in the fall in first year clover. If first year clover be cut or pastured in the latter part of the season, this menace will be largely removed. Of course, the first year's crop must not be pastured too hard nor cut too close. If reasonable discretion is used, the clover will not be injured by this treatment.

The **Clover Leaf Weevil**, *Phytonomus punctatus*, is a brown, finely punctured snout beetle or curculio, nearly one-third of an inch long. The sides of the prothorax and of the wing covers are pale yellowish in color. There are small, black spots on the wing covers and three pale yellow lines running longitudinally along the back of the prothorax, the longest in the middle. These beetles lay their eggs in the clover fields during September and October, some as late as November. The eggs hatch soon after being laid and the greenish white larvae feed at first by making little round holes in the leaflets. A little later, they eat notches and semicircles from the edges of the leaflets. Most of the feeding is done at night, and in the daytime they are usually curled up on the ground, under trash or in other shade. They hibernate over winter between the bases of the clover stems or under other protections. Pasturing lightly all first year clover in the fall would tend to discourage them, and plowing under the second year crop in the fall, or in early spring, would bury and destroy all in the field.

Often in the latter part of the season, clover plants wilt and die. Such plants may break off easily at the crown. Further investigation may show the roots to be hollowed out, and in them, probably some very small brown beetles or the pupae or larvae of the same

will be found. The name of this insect is the **Clover Root Borer,** *Hylesinus trifolii* (*Hylastinus obscurus*). It is second year clover and that which is older that is attacked. Copious rains may enable infested fields to survive the attack, but the crop of seed will be very light in any case. A few larvae may be found in the roots in September, but most have changed to pupae, and most of the pupae will have transformed to beetles before the first of October. The beetles hibernate in these burrows over winter. The eggs are not laid until spring. There is practically nothing that can be done in the fall against it. However, it is well to take note of its presence and lay plans for the future. See Summer Manual for remedy.

When the time comes to stack clover hay or to put it in the mow, care must be taken not to put it on the butts of old clover hay stacks nor upon old clover hay that has been carried over in the mow. If unloaded in such situations, the new hay as well as the old is apt to become infested with dull, brown caterpillars about three-fourths of an inch long. The infested hay presents a moldy appearance, being interwoven with fine, silken webs and scattered through the mass are black pellets of excrement as if finely ground slack coal had been sifted into it. The moths are seen flying during late August, throughout September, and on into October. The wing expanse is a little less than one inch. The silky wings have a purplish cast, margined with orange and fringed with golden yellow. On the front margin of each fore wing are two golden spots, which divide the wing into thirds. Each spot gradually contracts into a lilac line extending to the posterior margin of the wing. The middle of each hind wing is crossed by a wavy yellow line, which deviates from a general parallel course with the margin to meet the posterior angle, and inside this line is one of similar color about one-half way to the base. This insect is known as the **Clover Hay Worm,** *Hypsopgia costalis*. The second brood of larvae appear in late August and on into late fall. They pass the winter in the caterpillar stage. Hay that has been badly attacked by them is not fit for consumption and is rejected by live stock. Remove all old clover hay from the mow before putting in the new. Hay stacked outside should never be put on the butts of old stacks nor near old hay. Remove or burn such hay before stacking the new, else choose a new stack yard at some distance from the old. Put a foundation of logs or rails at the bottom of such a stack so as to keep the hay from the ground and thus admit air beneath. The larvae are active in winter in barns and in the bottom of stacks that furnish sufficient warmth. A cold, dry blast of winter air beneath the stack is discouraging to them. Salting the hay in the bottom of the stack to a depth of two or three

feet will protect against the worms. If the worms have once gotten a foothold, restack and dust with pyrethrum powder. Mix the insect powder with five times its weight of flour and sprinkle over the hay as the stacking proceeds. It would be well to salt the hay at the same time, using about three or four times as much salt by weight as of powder and flour.

The **Clover Mite,** *Bryobia pratensis*, is a small, dark red spider which causes some whitening of the foliage of clover. It ascends trees in the fall and lays great numbers of bright red, spherical eggs, so small that they will scarcely attract attention at all, unless massed together in considerable numbers. In spring and autumn, the mites frequently cause annoyance by crawling up the walls of dwellings and swarming into the rooms through the doors and windows. A line of tangle-foot around the walls of the building is probably the surest way of keeping them out. Spraying orchard and shade trees upon which the eggs are laid with lime-sulphur solution in late fall or early spring will, in all probability, destroy many of the eggs.

A very common, but not a very serious enemy of clover, is the **Clover Drasteria,** *Drasteria erechtea*. The moth can be found in clover fields from rather early spring until late in fall. It has a wing expanse of about one and one-half inch. The wings are grayish brown, crossed transversely with lines and bands of darker brown. When disturbed. it takes a short and jerky but rather rapid flight. The caterpillar is a measuring worm, striped with brown and gray lines, with a double whitish line down the back. When full grown, it is over an inch in length. When about to pupate, it fastens several leaves together, lines them with silk, and then changes to a chrysalis, in which state it passes the winter. No special remedies are called for. Late fall and early spring plowing of second year clover destroys many of the eggs, larvae and pupae.

Almost any time during the fall, from early September until well into October and early November, the **Clouded Sulfur Butterfly** or **Clover Butterfly,** *Eurymus philodice*, can be seen flying over clover fields. The wing expanse varies from one and one-half to two and one-half inches. The color varies from pale sulphur to lemon and bright yellow. The outer borders of the wings are clouded with black or blackish-brown. Some of the females are white instead of yellow. There is a black spot on the disk of each fore wing and an orange spot near the middle of each hind wing. The mature larva is over an inch long—nearly an inch and one-half, of a dark green color, paler on the under side. A creamy white stripe runs along each side of the body, and through the middle of this runs a

streak of crimson, broken at the segment joints. Below this stripe is a series of black spots along the sides. The pale green chrysalis is attached by its tail and by a loop around its body to the stems of clover or other plants. It passes the winter chiefly as a chrysalis, though a few hibernate as larvae. No special remedies seem to be needed. An incidental effect of fall and spring plowing of second-year clover is to bury and destroy a good many of these larvae and pupae.

The **Flavescent Clover Weevil** or **Clover Sitones**, *Sitones flavescens*, is a snout beetle or weevil, quite resembling in general form the Clover Leaf Weevil, *Phytonomus punctatus*, but the species under consideration is smaller, being about three-sixteenths of an inch long. The color is rusty brown, the body and legs being clothed with short, dense hairs. On fresh specimens, there is a pale line extending along the middle of the back of the prothorax, and a pale line also extends along each side of the prothorax and forward on the head above the eyes and along the beak; and also backward on the wing covers for a short distance. This beetle is quite common in white clover and also to a somewhat lesser extent in red and alsike clover and alfalfa. It eats semicircular notches from the edges of the leaves. If it happens to feed from the edge of the midrib side of a young leaf not fully expanded, a rounded hole appears in the leaf when it opens. During the day, the beetles hide away under rubbish about the roots of the plants. The eggs are laid throughout the fall months and hatch in a few days. The stout, yellowish-white grubs, a little over one-fourth inch in length when matured, feed when first hatched, on the tender tissues where the stems join, but later they descend to the roots to spend the winter. The beetles go into hibernation quarters under such cover as the ground affords at the beginning of winter, but it is doubtful if any of them survive until spring. The chief damage to the clover is inflicted by the older larvae feeding on the roots. Plowing second-year clover in the fall or early spring destroys many of the larvae, practically all of them, and, at present, no other measures seem to be needed.

The **Clover Root Curculio**, *Sitones hispidulus*, is a close relative of the preceding species, but is about one-third smaller and is black in color. There is probably no fall brood of larvae in case of this species, though eggs are possibly sometimes laid in the fall. The rule, however, seems to be that the beetles hibernate under rubbish on the ground and lay their eggs in the spring. Fall plowing or other autumn remedies would probably have little effect on this species.

Almost any time in fall a few beetles of the **Clover Stem Borer,** *Languria mozardi*, may be found hiding away under trash on the ground in clover fields. This is a long, slender beetle, with dark, steel-blue wing-covers and a shiny-red or yellowish-red thorax and head. The antennae are black, the legs red with the outer half of the femur black, and the tibiae and tarsi are more or less inclined to be dusky. The length of the beetles varies from one-fourth to one-third inch. They hibernate over winter and lay their eggs in the spring. The larvae burrow inside the larger stems of clover and consume the pith. Late fall plowing of second year clover may possibly bury the insects so that some would perish, but most of them would probably work their way to the surface in the spring and escape. Fortunately, this is not a serious pest.

The **Clover Root Mealy Bug,** *Pseudococcus trifolii*, is a whitish, powdered, louse-like creature which sucks the sap from the roots of clover and allied plants. They cause wilting and dying of the plants they infest, especially in dry weather. Owing to the slowness with which the insect spreads, it seems that the ordinary system of plowing up clover at the conclusion of two seasons, and planting the ground to other field crops will take care of it without further attention. Either fall or spring plowing would be satisfactory.

Occasionally correspondents send us, in the fall, clover heads containing many very small, slender, blood-red insects. A few may be darker in color and some are black. The black adults are provided with slender, feathery wings, and all are very active. They largely confine their damage, which is generally not serious, to the heads. This insect is known as the **Clover Thrips,** *Phloeothrips niger*. It becomes most numerous during extended periods of dry weather. No satisfactory remedy has yet been suggested.

SUMMARY OF REMEDIES

1. **Keeping down volunteer clover and late bloom in the fields,** by clipping, tends to check multiplication of the following insects, viz:—

Clover Seed Chalcid and **Clover** or **Pea Louse.**

2. **Lightly pasturing clover in the fall,** especially first-year clover, tends to hold the following insects in check, viz:—

Clover Seed Chalcid, Clover Seed Caterpillar, Clover or **Pea Louse, Clover Leaf Weevil,** and to a lesser extent, various caterpillars and other insects.

3. **Very early fall plowing** of second-year clover is needed for the **Clover Root Borer.**

4. **Late fall plowing** of second-year clover is useful to restrict the multiplication of the **Clover Seed Midge, Clover Seed Chalcid, Clover Seed Caterpillar, Clover Leaf Weevil, Clover Drasteria Clouded Sulfur** or **Clover Butterfly, Clover Sitones,** and **Clover Root Mealy Bug.**

5. **Cleaning old hay from the mow or stack-yard and building the stacks on foundations of logs or rails,** and salting the butts of the ricks protects against the **Hayworm.**

6. **Spraying the eggs of the Clover Mite** when they are clustered on the bark of trees, with lime-sulphur solution in fall, will operate against this annoying, but not dangerous pest.

INSECTS WHICH ATTACK TOBACCO

It is well to give some consideration in the fall, both to the field then planted in tobacco and to the one which it is intended to plant to this crop the following season. If the next year's tobacco crop is to be planted on land which is in grass, clover, or some similar crop, tending to favor the multiplication of **cutworms,** an examination should be made to determine whether or not fall plowing should be adopted. If the cutworms are plentiful, plow in fall. **Webworms** which develop most abundantly in grass crops are also controlled by early fall plowing. Where the lands will stand fall plowing, and either one of these classes of insects are abundant, plow quite deeply in September, if possible; if not, as soon thereafter as circumstances will permit. Fields which have just matured a tobacco crop are best plowed up late in fall after the crop has been removed, provided the land is of such character that it will stand fall cultivation. The pupae of the **Tobacco Worms** or **Tomato Worms,** *Phlegethontius quinquemaculata* and *Phlegethontius sexta* are thus thrown up and exposed to the effects of winter, which destroys most of them. The caterpillars, upon descending into the earth, make enlarged cells in which to hibernate as chrysalids. Their bodies are but little in contact with the walls of the roomy cells, and extreme and sudden changes of temperature cause but little shock to these comfortably housed pupae, with a thick blanket of air about them which contracts or expands according to the temperature, without harming the occupants. If the plowing be done before pupation has occured, the larvae will probably construct new cells and pupate a little later. If the plowing is done after pupation, the cells are broken and the helpless chrysalids will be thrown to the surface, or will be obliged to lie during the winter with the earth in close contact with their bodies. In either case, nearly all of the pupae will die. Each pupa killed, means a lessening of the crop of worms for the following

summer. The moths are strong fliers and go a long distance, if necessary, to find new fields in which to breed. If these caterpillars, sometimes known as "horn" worms, are feeding plentifully as late as September, spray with arsenate of lead or with Paris green. A knapsack pump is commonly used for this purpose. In some respects, dusting with these arsenicals is more satisfactory than spraying. Mix Paris green with twice its weight of ground lime and apply with a suitable powder gun or dusting machine. These worms must be destroyed before the tobacco is cut and stored, otherwise they will continue to feed upon the drying leaves in the barn. If, by chance, some are carried in, fumigate the storage rooms with bisulfid of carbon, three pounds to each one thousand cubic feet of space enclosed. Remember the precautions that must be observed when this gas is used (see page 87).

Shortly after the tobacco harvest, spray or dust the remnants of plants left in the field and the weeds around the borders of the field with an arsenical poison. Such insects as the **Tobacco Flea Beetle**, *Epitrix parvula*, congregate on these remnants and weeds after the removal of the crops and may thus be poisoned in large numbers. The adults of the Flea Beetle hibernate over winter under piles of dead leaves or in dead grass in the woods, in fence corners, etc. The removal of such shelters in late fall by burning or otherwise is desirable. These insects leave their retreats very early in spring, giving but little time for burning at that season.

SUMMARY OF REMEDIES

1. Early fall plowing is useful against webworms.
2. Late fall plowing is useful against cutworms and the tobacco or "horn" worms.
3. Spraying or dusting with arsenicals in September is useful against the tobacco or "horn" worms.
4. Fumigating with bisulfid of carbon is useful against "horn" worms feeding on stored tobacco.
5. Spraying or dusting weeds and remnants of tobacco crop with arsenicals in late fall is useful against the Tobacco Flea Beetle.

TREATMENT FOR GRANARY PESTS

In common language, the term "weevil" is of very indefinite application, the name being more or less indiscriminately applied to any species of insect which feeds upon stored grain. There is well-nigh a score of species that are quite commonly found in grain bins and to any one of which this term is quite generally applied. Among them may be named the **Rice Weevil**, *Calandra oryzae*, and the **Granary Weevil**, *Calandra granaria*, both being very small,

brown or brownish snout beetles and both true weevils. Another common marauder is the **Dark Meal Worm**, *Tenebrio obscurus*, a larva that much resembles a wireworm in superficial appearance, but its glossy, waxen skin is of darker color than that of most wireworms, and the last segment of the body is much more nearly rounded out and less complex than in the wireworms. This is the larva of one of the **Darkling Beetles**, the adult being about three-fourths of an inch long, somewhat slender and flattened. Its color is dull black. The **Yellow Meal Worm**, *Tenebrio molitor*, is very similar, but somewhat lighter in color. The adult beetle is of a more brilliant black than *T. obscurus*. The **Cadelle**, *Tenebroides mauritanicus*, is much smaller than either of the two preceding species, and partially subsists upon other insects as well as upon grain. The full grown larva is about three-fourths of an inch long and the elongate, flattened, blackish beetle is about one-third of an inch in length. The **Saw-tooth Grain Beetle**, *Silvanus surinamensis*, is one of the smallest and at the same time, one of the commonest inhabitants of grain bins. It is a flat, brownish insect, about one-tenth of an inch long. The thorax has a row of six minute points or teeth on each side, hence the common name given to the insect.

The **Angumois Grain Moth**, *Sitotroga cerealella*, is about one-fourth of an inch long and, as the common name indicates, it belongs in an entirely different order of insects than the beetles. The moths are light gray in color, with black lines on the fringed wings. The wing expanse is about three-fifths of an inch. The **Indian Meal Moth**, *Plodia interpunctella* expands over one-half inch and has the inner third of the fore-wings whitish in color while the outer two-thirds is brownish. The fringed hind wings are whitish. The larva, which becomes somewhat less than one-half inch in length, fastens masses of food particles together by means of a profuse silken web. The **Mediterranean Flour Moth**, *Ephestia kuehniella*, is a pest in mills and in the family flour chest, but is not specially destructive in grain bins. The pinkish caterpillar attains a length of about one-half inch and has the obnoxious habit of spinning silken tubes through the materials in which it feeds, thus rendering them unsuitable for use. The adult moth has a wing expanse of nearly an inch, the forewings being of a grayish color with transverse dark bands. The hind wings are whitish with a darker border. The **Meal Snout Moth**, *Pyralis farinalis*, is somewhat the largest of the moths commonly found in grain bins, the wing expanse being nearly an inch or a little more. The color is reddish brown, the wings being crossed transversely with wavy white lines. The hind

wings are lighter than the front pair. The yellowish larva is about an inch long and lives in an extended silken tube. Particles of grain or of other food material, whatever it may happen to be, are woven into the walls of the tube and adhere to it when it is lifted from the bin.

Some of these insects are rapid breeders, passing through several generations annually. The two true weevils mentioned pass through four or five generations per season, the various moths through from two to six, and the cadelle and the meal worms through only one.

Preventive measures are more important than remedial ones in minimizing damage by these insects. Some of them attack the grain in the field and are stored with the grain. The extent of field infestation may be somewhat reduced by an *early harvest.* However, the great source of infestation is slovenly-cared-for bins. All old grain in the bins should be removed before the new grain is stored. Care must be taken that no knot-holes, mouse holes or leaks of any description allow any of the grain to run beneath the floor. Such a leak spills the grain exactly where the insects can find it, and furnishes them with just the facilities needed to encourage rapid and perpetual breeding. If bins are tight and all remnants of old grain are carefully swept up and removed before the new grain is stored, there is not much liklihood of severe damage by such insects in Ohio latitudes. A thorough whitewashing, or painting with coal tar, of the inside of the bin will help to fill dark crevices in which the insects are fond of hiding. Metal bins with concrete foundations will doubtless help very much to protect against injury from both rodents and insects if the walls are unperforated and the question of ventilation is properly solved. It is best to have the granary at some distance from other buildings and if wood is used for its construction, make the walls of the bins of matched flooring or of similar materials. All doors should be tightly fitted and should be closed upon a rabbet covered with some sort of packing or cushion. The windows should be covered with fine wire gauze to prevent the entrance of insects. Very large, cool, well ventilated bins discourage insect multiplication, while any kind of mild heat, whether from fermentation (heating and sweating) or artificial sources encourages it. However, high temperatures are fatal to grain insects if long continued. A well planned heating system in a mill or granary furnishes the most effective and cheapest method of exterminating these pests. Either steam coils or hot water radiators with sufficient radiating surface; or a well planned hot air system of heating will prove sufficient to control the insects, if the

period of heating is extended for a little time. According to experiments by the Kansas Agricultural Station, a temperature of 118 degrees kills the larvae, pupae and adults of the Mediterranean flour moth, the same temperature destroys the adults of the rice weevil, and 119 degrees kills all stages of the saw-toothed grain beetle. The cadelle beetles perish at 120 degrees continued for three minutes. Wheat was subjected for 8 hours to 150 degrees without injury to its germinating qualities. The heat may be turned on a mill or granary over Sunday and if it ranges from 115 degrees to 120 degrees for several hours, all the insects will be dead by Monday morning.

If old bins have been badly infested and are being prepared for the reception of the new harvest, after cleaning them out as previously directed, fumigate by burning flowers of sulfur, three pounds to one thousand cubic feet of space, for 24 hours. The sulfur should be placed in a metal kettle and one side of it dampened with alcohol, after which apply a match. This treatment is also fairly effective for destruction of insects in the grain, but at the same time ruins the germinating power of the grain so it cannot afterwards be used for seed. A better treatment for grain, intended for seeding, where heating is not available, is to fumigate with bisulfid of carbon, using three pounds to each one thousand cubic feet of space, for thirty hours. Repeat the application three weeks or a month later so as to catch the larvae and pupae which escaped the first treatment and have since transformed to adults. In cases of very severe infestation, a third treatment a month after the second may be needed. Bisulfid of carbon is poured into shallow containers such as tin pans and set on top of the grain. The fumes, being heavier than air, will settle downward into the grain, destroying the adult insects that have escaped to the top and many of the adults and immature forms buried in the grain. Where the grain is quite deep in the bin, insert a piece of gas pipe into the grain with a stick inside. When a proper depth has been attained, withdraw the stick and pour in about one-fourth pint of liquid. Sink the gas pipe in similar manner into the grain at different places and to different depths until the dosage is sufficient to fumigate the bin. It is well to shovel the grain over as much as possible, but care must be observed not to inhale the fumes for a very long period or asphixiation may occur. Carbon bisulfid is very inflammable and no light of any kind should be brought near the bins while fumigation is in progress. Lighted cigars, lanterns, etc. are dangerous. If the grain bins are near stalls in which animals are kept and on the same floor, turn the creatures out of doors or keep them elsewhere

until the fumigation is completed. If the animals are stabled on a different floor, they may be allowed to remain in their accustomed places provided the doors and windows are left open to furnish them with plenty of fresh air. The germinating quality of grain is not much injured by this treatment, provided it is not extended beyond 48 hours. From thirty to forty-eight hours is the usual period. If the bins are in any wise open, make them as tight as possible and increase the dose, also the number of applications.

Hydrocyanic acid gas is more effective against most insects than is bisulfid of carbon, although perhaps not so penetrating, but this is a very dangerous gas to use and should only be handled by experienced operators, or by persons who have carefully studied plain and detailed instructions how to use it. Persons wishing such instructions should procure Johnson's Fumigation Methods, published by the Orange-Judd Company, New York City, or some similar manual of fumigation practice.

ORCHARD PRACTICE

PROTECTION FROM ANIMALS

In late October or early November, means should be provided to protect orchard trees from rodents, particularly mice and rabbits. Consult Bulletin No 208 of this Station for details regarding methods to be employed and their comparative merits.

Briefly presenting a few such devices:—

1. A soil or cinder mound, firmly tamped, to a height of four to six inches, and twelve to sixteen inches in diameter, affords good protection against mice. Keep grass and litter cleaned well away from the trunks of the trees in orchard, woodlot, and nursery.

2. Place around the trunk a cylinder of galvanized wire screen with one-fourth inch mesh. Use pieces about 12x24 inches in size. These are rolled longitudinally around a broom handle and thus shaped into cylinders about three inches in diameter. The natural tension of the wire closes the cylinder and keeps it in position. Allow the edges to lay over about one inch. This protector excludes both rabbits and mice.

3. A paint which is of value in preventing damage by rabbits and mice is made as follows: Sulfur 4 lbs; yellow ocher, 4 lbs; flour, 4 lbs; linseed oil, 4 lbs; turpentine, 4 ozs; asefoetida, 4 ozs; dissolved in one pint alcohol; six eggs. Stir with these materials enough buttermilk to make a thick mush; then add sufficient sweet milk to make a thin paste. Apply with a brush.

4. A white paint made by mixing raw (unboiled) linseed oil and pure white lead has been used very successfully in some localities to protect apple, pear and quince trees from rabbits, mice and borers. It should be used very cautiously, *or better not at all*, on peaches, plums, cherries and other stone fruits. Mixed paints containing drying oils or cotton seed oil in them are dangerous to all sorts of trees, therefore, only raw linseed oil and pure white lead should ever be used in mixing this paint.

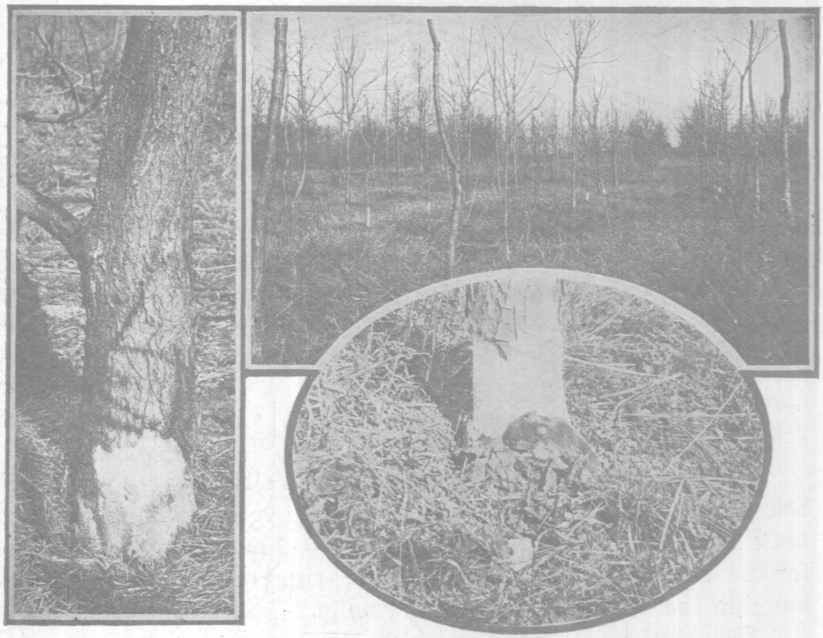
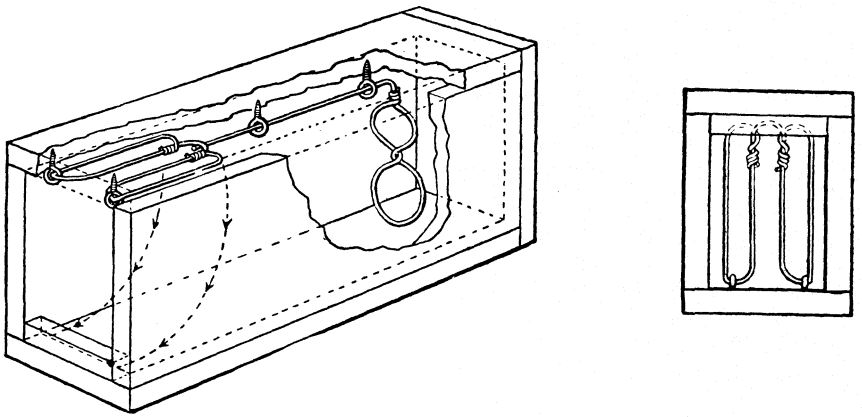


Plate III.

Work of field mice girdling trees; note the weedy covering over the ground at the bases of the trees and through the plantation, providing the cover under which the mice delight to live.

5. The Wellhouse rabbit trap is easily made and readily catches the creatures. It is not patented and not on the market, but can be made by any farmer from these directions taken from the writings of D. E. Lantz, Yearbook U. S. Department of Agriculture, 1907: "The trap is a box made of 6-inch fencing boards, old ones being preferred. The box is about 21 inches long, closed at the back by a board, but in front by a wire door only. The door is hung from the top and swings inward. A cleat at the bottom prevents its opening outward. The trap is set and the wire door is kept open by a wire trigger-rod, held in place by two staples fastened to the top of the box. This trigger is bent downward near the rear of the trap and formed into a loop or a figure eight. As the rabbit enters the trap

and crowds into the back part, it pushes upon the loop, moves the trigger wire backward, and releases the wire door. This falls and makes the rabbit a prisoner. Bait may be used, but is not necessary, since the cottontail is constantly looking for dark places to hide from enemies or cold winds. Mr. Wellhouse uses about three traps per acre in young orchards and many among the bearing trees. They are regularly looked after by boys, and so effective have they proved that no serious losses from rabbits have occurred in his orchards.



The Wellhouse Rabbit Trap.

The materials needed for making a Wellhouse trap are: Four boards 1 by 6, 21 inches long; one piece 1 by 6, 8 inches long for the back; a short cleat for the door stop; 28 1-2 inches of wire to serve for the door; 22 inches of wire for the trigger; four small staples for hanging the door and trigger; and nails."

Descriptions of other valuable protective devices and suggestions for repairing injuries inflicted by rodents are given in Bulletin 208 Ohio Agricultural Experiment Station.

INSECTS OF THE APPLE ORCHARD

SEPTEMBER

While most of the pupae of the Plum Curculio, *Conotrachelus nenuphar*, will have transformed and left the ground as beetles before September, there may still remain in the soil a sufficient number to justify cultivation of a badly infested orchard during the first week in September, if no plowing was done during July or August. Cultivation later than the first week in September would be of little benefit. The larvae and pupae which lie in the soil from one-fourth inch to three and one-half inches deep, perish quickly if exposed to the drying effects of sunlight and air. Also birds, ants and ground beetles readily find and destroy many when they are

exposed by cultivation. Poultry running in the orchard in the fall will devour many of the beetles. The more carefully all weedy growth in and around the orchard is kept down in the fall, the less will be the chance for the beetles to find suitable hibernating retreats for the winter. By picking up and disposing of the fallen fruit as promptly as possible after it drops, some late developing larvae will be caught and destroyed. Much of the puncturing done on apples and peaches in late summer and fall is due to the plum curculio.

The **Apple Curculio**, *Anthonomus quadrigibbus*, is generally found hiding under leaves on the ground or concealed under similar shelters during the fall. Clean practice in and around the orchard and giving to poultry the free run of the orchard lot will assist somewhat in reducing its numbers.

The **Codling Worm**, *Carpocapsa pomonella*, will be reduced somewhat in numbers if the fallen fruits are promptly picked up, removed from the orchard, and so disposed of as to insure the destruction of all larvae contained in them.

The **Yellow-necked Datana**, *D. ministra*, is often conspicuous and quite injurious in September. Most of the caterpillars are well grown before the middle of the month and are ravenous feeders upon apple and other orchard and forest trees. The full-grown caterpillar is about two inches long with a black head and a yellow neck. A black stripe extends down the middle of the back and three stripes of the same color, alternating with four yellow stripes, extend along each side. The body is quite hairy. The caterpillars are gregarious and collect together in large numbers out towards the ends of the twigs. If the branch is jarred or the caterpillars are in any way disturbed, they cling for support with their four middle pairs of legs, and elevate both ends of their bodies in the air at right angles to their support. Sometime in September, they all descend to the earth and burrow beneath the surface from two to four inches, where they pupate. When the colonies are young, they are confined to a single small branch, which may be cut off and burned. After they become more mature, resort to hand-picking or spray the trees on which they are feeding, if not carrying fruit, with arsenate of lead, 5 pounds in fifty gallons of water. Kerosene emulsion may be diluted with 12 to 15 parts of water and sprayed directly on them. Make oil sprayings only on dry, sunshiny days so as to avoid all danger of injury to the foliage. The raincrows or cuckoos feed quite freely on these hairy caterpillars, which are shunned by most birds.

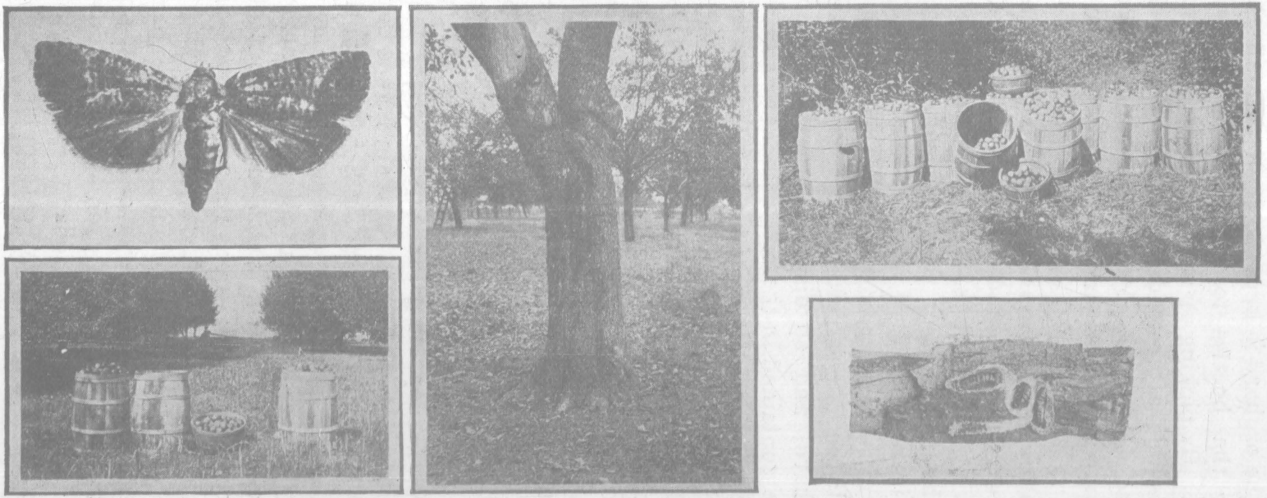


Plate IV.

Codling Moth, *Carpocapsa pomonella*, and Woolly Aphis, *Schizoneura lanigera*.

Codling Moth; also chrysalids in cocoons spun under loose bark. Apple crop from properly sprayed tree in upper right hand corner; fruit infested with codling worm in basket on ground, all other fruit free from worms. Apple crop from unsprayed tree shown in lower left hand corner; fruit infested with codling worm in barrel to the right, all sound fruit in group of containers to the left.

Tree trunk shows cankers and barkless areas, extended and probably initiated by the woollyaphis, which, in great numbers, clusters around the margins of the diseased area.

Plate V.

The Fall Canker Worm, *Alsophila pometaria*, caterpillars, eggs and moths caught in tanglefoot band.
Trees nearly defoliated in early summer by canker worms.

During August and September, a singular caterpillar is occasionally found feeding on apple foliage. It is reddish brown, variegated with white on the back, and has a green patch on each side, extending over the second and third segments, while from the top of the fourth a conspicuous horn is projected. It eats out a notch from the edge of the leaf and then fits itself to the notch, clasping the eaten edge of the leaf with its prolegs while the prominent horn is made to extend over a portion of the vacant space where belonged the devoured tissue. The outline of the back, thus simulating the irregular edge of the leaf, enables the caterpillar to elude the sight of all but the most searching eyes. This caterpillar is known as the **Unicorn Prominent**, *Schizura unicornis*, and though interesting, rarely, if ever, becomes sufficiently numerous to be troublesome. It reaches full size in September and descends to the ground, where a cocoon is constructed under the fallen leaves and trash. The light-brown moth does not appear until the following summer. No measures against this insect are needed under ordinary circumstances. If a midsummer spraying with arsenate of lead is made in July or August, these caterpillars are apt to be thinned down until they attract no notice.

In late August and early September, colonies of the **Red-humped Caterpillar**, *Schizura concinna*, may be found clustered on branches which are being rapidly defoliated. These caterpillars have a coral red head and there is a red hump on the fourth segment. Fine, yellowish, black and white lines run lengthwise of the body and there are two rows of black prickles along the back and other shorter ones along the sides. The hinder segments taper somewhat and the last segment is spotted with black. When full grown, the caterpillar is about one and one-fourth inches long. When not feeding, these caterpillars cluster closely together on a branch and elevate the hinder part of the body much after the fashion of the yellow-necked caterpillar. (See page 91.) When handled, they exude a transparent fluid, having a pungent, disagreeable odor, this constituting a defense against insectivorous birds. In early September, or before, the larvae descend to the earth and pupate in the fallen leaves upon or only slightly beneath the surface. The brownish moths do not appear until the next June and July. The remedies suggested for the yellow-necked caterpillar (See p. 91) will apply here. The caterpillars can also be jarred loose from their resting places and killed while on the ground.

During September and October, the ugly nests of the **Fall Webworm**, *Hyphantria textor*, are conspicuous on both orchard and shade trees. The caterpillars are very hairy, being usually whitish

or yellowish in color. The head is black and there are blackish spottings and linings, considerable variation being observable in different specimens. Full grown caterpillars are a little more than one inch long. Hundreds of them are usually found in a web which entirely envelops the branches, leaves and all. If trees are sprayed thoroughly about the middle of July or the first of August with arsenate of lead, the young caterpillars will be destroyed soon after hatching. If webs are numerous in an apple orchard of rather low-headed trees, one of the quickest methods of handling them is to ride from tree to tree on a quiet horse, and without dismounting, strip the webs, worms and all, from the branches into a large gunny sack. When the sack is filled, it may be burned or it may be turned inside out over a low fire and the worms shaken into the flames. A kerosene torch attached to a long pole may be held under the nest in some cases, and the caterpillars burned while still in the tree. However, the torch is apt to do severe injury to the twigs unless great care is taken to shift the flame quickly from place to place and thus avoid burning and killing the tender growth. A straight stream of kerosene emulsion ejected from a powerful pump may do good work by tearing through the web and wetting the caterpillars with the spray. When the branches supporting the webs are not too large, they may be cut off and burned. Thorough spraying with arsenate of lead while the caterpillars are still young will be the most satisfactory remedy.

The second brood of the **White Marked Tussock Caterpillar,** *Hemerocampa leucostigma*, appears in August in Ohio and feeds during September and probably until well along into October. The head of the larva is coral red. Along the back are four compact tussocks of creamy white hairs. Two long, black pencils of hair project obliquely upward over the head and a single pencil of the same color extends obliquely upward over the back of the body. Where orchards are properly sprayed during the early part of the season, there is scarcely a possibility of serious damage by the second brood. Spraying with arsenicals will destroy the fall brood as well as the first, and in case of excessive annoyance, this measure can be supplemented by putting tanglefoot bands on the trunks to prevent the ascent of the worms. Also, see Winter Manual, page 15.

Throughout the entire fall, may be found on apple and other orchard and forest trees, a true bug about one-third of an inch long, light grass green in color, and shaped much like a beechnut. On the front, projecting out from each side laterally, is a sharpened angle or horn, more or less suggesting the horns of a buffalo; hence, the name applied to it, **Buffalo Tree Hopper,** *Ceresa bubalis.* This

insect inflicts severe damage to the twigs of various trees, owing to its mode of egg-laying. It usually works on the upper surface of the twigs and seems to prefer the south side of the trees. The twigs selected for oviposition are generally of the second or third years' growth and may be borne by either old or young trees. Two opposing slits, slightly curved toward each other, and lying in the same general direction as the twig, are each made the repository of several eggs, usually of from six to twelve. The space lying between the two slits dies. These pairs of slits are ranged together in two parallel rows, lengthwise of the twig, and since the deadened space does not grow as does the rest of the twig, such limbs, in time, become badly scarred and weakened, often snapping off in a gust of wind. After a few years, each pair of slits takes on the form of an oval scar, and a line of these will extend along the limb. So far as possible, keep down all weedy and shrubby growth in and around the orchard for a considerable distance out, and thus starve the insects away. As soon as possible after the leaves drop in fall or winter, cut out the twigs containing punctures and burn.

In some cases, this pruning will be impossible since the entire top of young trees would need to be cut out to get rid of all the eggs. In such cases, trim out the smaller and worst injured limbs, leaving enough top to forward growth. If all the limbs are completely ruined, cut back to a whip so as to secure an entirely new top or replant. Such extreme injury will not occur if weeds are kept down all season, especially during the spring and early summer.

Another species, *Ceresa taurina*, much resembling the Buffalo Tree Hopper, lays its eggs in the blossom buds or in the terminal buds of bearing fruit trees during the fall. The eggs are inserted within the bud scales, seeming to cause little or no injury. The adult insect is slightly larger than *C. bubalis*.

A third species, *Ceresa borealis*, much resembling *C. bubalis*, and agreeing with the latter in size, has the egg-laying habits of *C. taurina*. It occasions but little damage. Another species of tree hopper, *Stictocephala inermis*, about the same size as *C. bubalis*, but more rounded on the shoulders and lacking the acute angular projections or horns which characterize the three preceding species, also lays its eggs in twigs, usually in wood of two or three years growth. The egg-slits are not made in pairs as in case of the Buffalo tree hopper, but a single egg-slit is made through an area of loosened bark previously prepared by making several oblique slits, radiating from a common central space, like the bones in the palm of the hand, from the wrist. Remedial measures are the same as

for the Buffalo Hopper, but any severe pruning is unnecessary because the injury inflicted by this species is not very serious, except in case of young orchards and excessive numbers of the insects.

The **Fruit Bark Beetle** otherwise known as the **Shot Hole Borer,** *Scolytus rugulosus*, is present in all stages on various fruit frees in the early part of September. The last beetles of the second generation disappear, generally speaking, about the middle of this month. For full information, see Peach Section, page 123.

The **Pear Blight Beetle,** *Xyleborus dispar*, also attacks apple. See page 116.

In young orchards, there is often severe damage from **Grasshoppers** in the fall. Spraying the trees with arsenicals is of some value, but should be supplemented by use of poisoned baits as suggested on page 78, Spring Manual; also see Summer Manual.

During August and September some woolly white caterpillars, with black tufts of hair along their backs, are found feeding upon the foliage of apple and sometimes they eat away the skin and part of the flesh of some of the fruit. These caterpillars are more frequently found feeding on the foliage of hickory, walnut, and butternut. Because of the coloration and spotting of the wings of the moth, this insect is known as the **Hickory Tiger Moth,** *Halesidota caryae*. The full grown caterpillars are about one and one-half inches long and have a row of eight black tufts along the back. There are two long black pencils on the fourth segment and two similar ones on the tenth segment. In late September or early October, the larvae spin coarse, grayish cocoons under stones, rubbish, or in some similar situation, and there transform to pupae, in which stage they pass the winter. Spraying with poison will check them. The young will be killed if the foliage is covered with arsenate of lead, adhering since the summer spraying for codling worm, made in late July or early August.

In September and early October, a large green "horn worm" is sometimes found on apple. There are seven oblique pale-yellow stripes on each side of the body, the seventh or posterior one being the most deeply colored and extending to the horn. This caterpillar may reach a length of two and one-half inches. Sometime in September or October, it buries itself in the soil and changes to the pupa. It comes forth the next year in early summer as a beautiful hawk-moth or Sphinx and is known as the **Blind-eyed Sphinx,** *Paonias excaecatus*. No other measure than handpicking will be needed, since the caterpillars are never numerous.

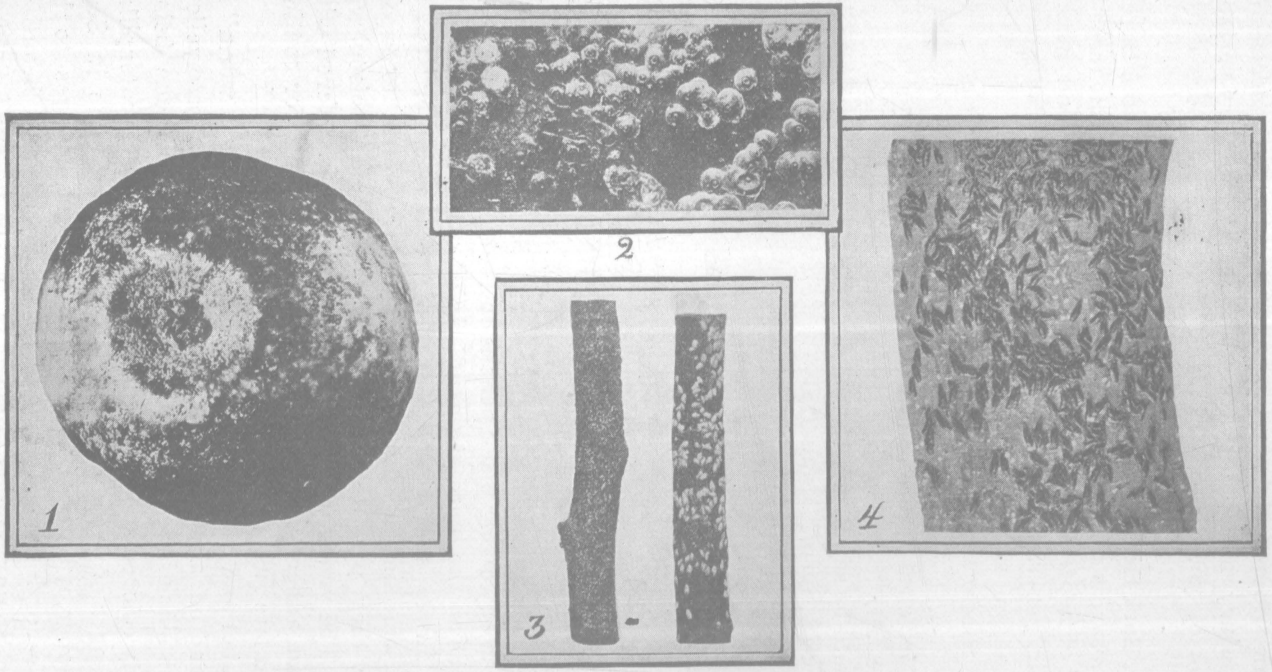


Plate VI. Scale Insects.

1. San Jose Scale, *Aspidiotus perniciosus*, on skin of apple.
2. San Jose Scale, enlarged on bark.
3. Scurfy Scale, *Chionaspis furfurus*, on twigs.
4. Oyster Shell Scale, *Lepidosaphes ulmi*, on bark.

Early in fall, sometime in September, or at latest in early October, is a good time to examine young apple trees to discover if borers are present. Give especial care to newly transplanted and sickly trees. Look over with particular care the southwest quarter of the tree which is subject to sun scald injury. A flattened or dried strip of bark, a slight exudation of sap, or the presence of sawdust castings are symptoms of borer infestation. Test the suspicious areas with a stiff pin or knife point to see if there are chambers beneath the bark. If so, open up the burrow and inject some bisulfid of carbon, closing the opening to the burrow with a plaster of clay mud, with grafting wax, or with a suitable plug of wood or paper. This treatment does not mutilate the tree. If the burrow does not extend too deep into the wood, the larva may be cut out and killed. Other suggestions are given in the Winter Manual, Page 18, and Spring Manual, Pages 50-51. The most common borers of apple found in such situations are the **Round Headed Borer**, *Saperda candida* and the **Flat Headed Borer**, *Chrysobothris femorata*. The last named species sometimes attacks the branches as well as the trunk

Plate VII.

Apple Tree Tent Caterpillar, *Malacosoma americana*, Moth, caterpillars and egg-ring encircling a twig.

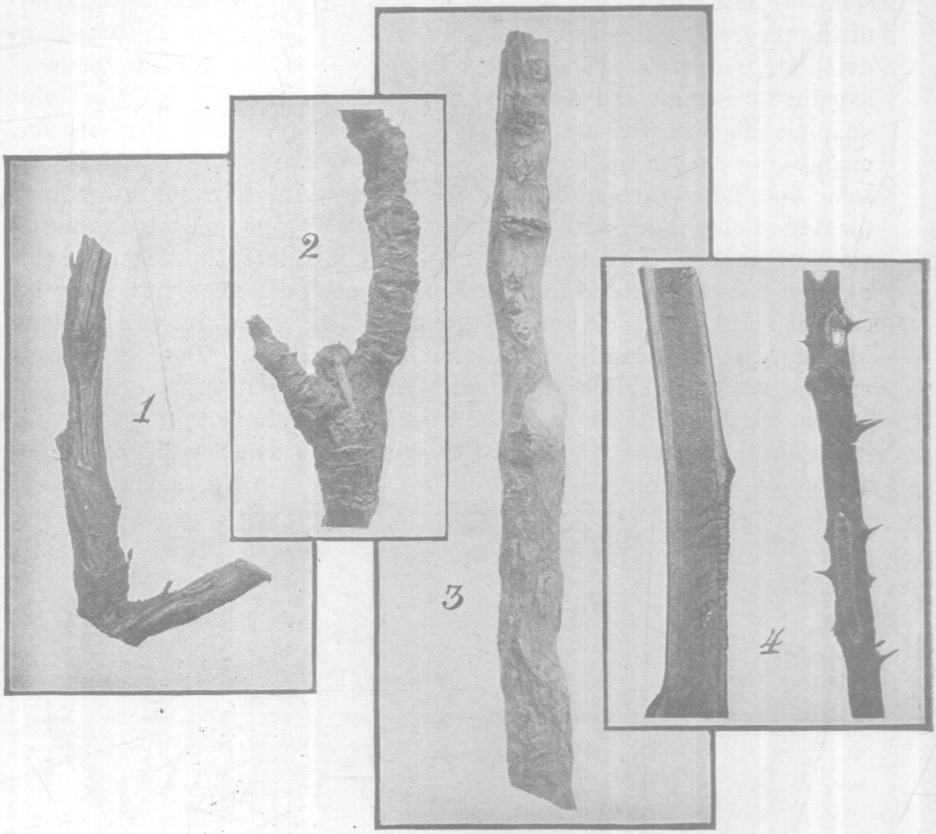


Plate VIII.

1. Seed-like cases (resembling buds) of the Resplendent Shield Bearer, *Coptodisca splendidiforella*, attached to twigs after the leaves are shed.
2. Cocoon of the Ribbed Cocoon Maker, *Bucculatrix pomifoliella*, in the fork.
3. Old scars from punctures, probably of both the Tree Hoppers, *Stictocephala inermis* and *Ceresa bubalis*.
4. Egg-punctures of Tree Cricket, *Ecanthus* sp. in raspberry cane.

The caterpillars of the **Apple Leaf-Sewer**, *Ancylis nubeculana*, fold the edges of the leaves together, commencing to feed inside the folded leaf sometime in July and continuing therein until the leaves fall in autumn. The larva is greenish yellow, with a yellow head and a horny plate of darker color just back of the head. On each side of the plate is a black dot. On each of the remaining segments are a number of pale, shining, raised dots, from each of which springs a single hair. When full grown, the larvae line their nests with silk and fall to the ground, remaining in the caterpillar stage until next spring. Sometimes the insect becomes sufficiently numerous to cause serious damage to the foliage. The summer spraying with arsenicals for codling worm doubtless kills many. Collecting and burning the fallen leaves and other rubbish is an excellent measure.

Also in early fall and continuing until late autumn may sometimes be found a rather stout, cylindrical, light-green worm, about an inch long and marked with five white longitudinal lines and numerous whitish dots. These worms are in the habit of feeding solitary and alone on the underside of the leaves, from the margins of which they eat regular notches or holes into the middle. This caterpillar is known as the **White-dotted Apple-Worm**, *Balsa malana*. When full grown, the caterpillar draws together a portion of the leaf with silken threads to form a hollow tube. This is lined with a thin layer of silk and the caterpillar then passes into the pupal stage. The chrysalis remains in the fallen leaf until the next spring, when it issues as an ashy gray moth with three irregular black lines crossing the front wings. There are two broods per season.

Throughout the summer and during September and most of October, a small greenish, leaping insect, known as the **Apple Leaf Hopper**, *Empoasca mali*, can be found on the undersides of apple leaves, especially those near the ends of branches, and on water sprouts where new and tender foliage is located. These insects are triangular in outline as looked at from above the back, and the wings which cover almost the entire body of the adult, fit closely over the back and against the sides. They are quite sprightly in their movements and, when disturbed, leap quickly into the air and take a short, hurried flight. When numerous, they cause the edges of the leaves to curl downward and growth of the trees is discouraged. They are also supposed to be responsible for inoculating healthy leaves and twigs with the germs of fire-blight. They deposit their eggs in the fall in small slits made in the apple bark. Earlier in the season they deposit eggs in various plants. Some of

them hibernate over winter in scattered places about the orchard. It is best to keep down all weedy growth in and about the orchard at all seasons and thus curtail the opportunity for egg-laying, and also the chances for successful hibernation.

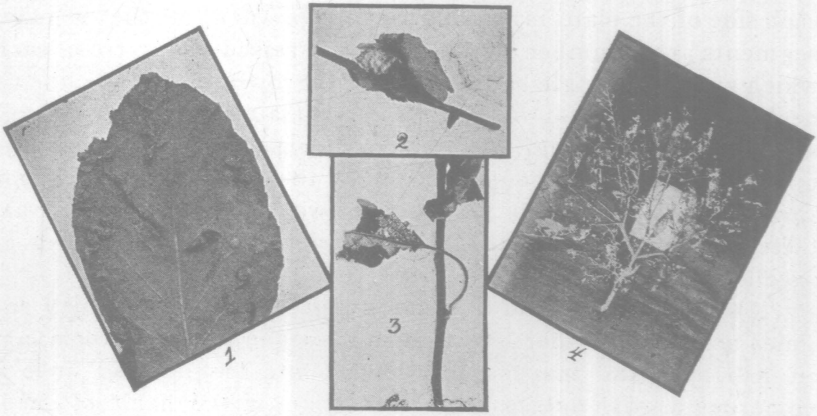


Plate IX. Some Orchard Insects.

1. Attached to the leaves are the seed-like cases in which the larvae of the Resplendent Shield Bearer, *Coptodisca splendidiforella*, live.
2. Frothy egg-mass of the White Marked Tussock Moth, *Hemerocampa leucostigma*, partially covered by a folded leaf.
3. Leaf eaten by the Leaf Crumpler, *Mineola indiginella*. Case of a larva attached to twig and nearly hidden by a crumpled leaf.
4. Leaves eaten by Bagworm or Basket Worm, *Thyridopteryx ephemeraeformis*, and swinging cocoon or basket shown in front of white card.

In late August and during the first half of September, a small caterpillar may be found making tortuous mines in apple leaves, some of the older worms at the same time feeding outside the mines and skeletonizing the leaves. This skeletonizing is done well out toward the edges of the leaves, which, when badly eaten, turn brown and curl up. Both the mining and skeletonizing work is done on the upper sides of the leaves. After leaving its mine, each caterpillar soon makes a silken, sheet-like cocoon near to the edge of the leaf, or over one of the larger veins, by crossing two sets of silken threads obliquely to each other. Beneath this shelter, known as the molting cocoon, the worm sheds its skin, then emerges through a crescent-like slit and resumes feeding as before. After a few days, generally in from three to five, a second molting cocoon is made. Then after the second molt, nearly a week is spent in feeding, at the conclusion of which period, the characteristic white ribbed cocoon that is to shelter the chrysalis through the winter is constructed. This is about one-fourth inch long, whitish in color, and has longitudinal flutings or ribs which have given the insect the

popular name of the **Ribbed Cocoon Maker** of the apple. It is also spoken of as the **Apple Bucculatrix**. The scientific name is *Bucculatrix pomifoliella*. The caterpillars gradually work from the tops of the trees down to the lower branches while making their successive molts, and the winter cocoons are, therefore, largely collected in the lower part of the tree. These are usually located on the under sides of the smaller branches and within two feet of the tips. A few are sparsely scattered over the larger branches and in the forks. Spraying infested trees with lime-sulphur solution after the leaves drop in fall is a very effective remedy, since nearly all of the pupae are thereby killed, if the work is thoroughly done.

In September, the leaves of apple and many other fruit trees may show the epidermis of one side and also the pulp from both sides of the midrib eaten away in large irregular patches, leaving only the papery white epidermis of the opposite side of the leaf and the veinlets spread over the eaten portion. Generally, beside the midrib, occasionally elsewhere, but quite certainly near the center of the eaten area, will be found a brownish, silken tube, open at both ends, and in this a small caterpillar which has been the perpetrator of the damage thus described. They move out of their tubes to feed. Sometime in September they leave their tubes and migrate to the twigs where they construct small winter cocoons or hibernaculae of silk in which they pass the winter months. The hibernaculae are firmly attached to the bark and appear as brownish, blister-like swellings near the buds. Spraying with lime-sulphur in October or November will destroy many of these caterpillars in their winter retreats. This insect is known as the **Bud Moth**, *Tmetocera ocellana*.

The **Apple Leaf Miner**, *Tischeria malifoliella*, works between the upper and the lower epidermis of the leaf, feeding on the pulp. The original portion of the mine starts from a point and then spreads out to make a trumpet-shaped excavation which is transversely banded with lighter and darker belts. This characteristically shaped portion of the mine has given to the insect the appellation of **Trumpet Leaf Miner** to distinguish it from other leaf miners of the apple. Besides this trumpet-shaped space, there is an irregularly shaped blotch of brownish color, which often includes part or the whole of the trumpet within its boundaries. The small caterpillar which makes this mine, lines the nest with fine white silk about September 1, or a little later, and ceases to feed. It remains in the mine over winter, falling to the earth with the leaf at the close of the season. These fall caterpillars are of the second brood.

The only remedy that we are able to suggest at present is to rake together the fallen leaves at the close of the season and burn them or else plow them under. It is not often that infestation becomes sufficiently severe to necessitate the adoption of any measures at all.

The **Apple Maggot** or **Apple Railroad Worm**, *Rhagoletis pomonella*, is a very important apple pest and demands close attention. Summer and fall apples suffer most but the winter varieties do not escape. The eggs, of which each mother fly lays about 400, are placed beneath the skin of the apple from July 1 until about August 1 and again from September 1 until sharp frosts appear. The maggot makes a dark, thread-like tunnel through the pulp of the fruit, causing decay and premature falling. Sometimes the tunnel is made just beneath the skin of the apple showing through as a zigzag, whitish track, something like the course of a railroad on a map, from whence is derived the common name "railroad worm". Full grown maggots may be found in the early summer varieties such as Early Harvest, by the middle of August or sooner, while the greater number or second brood mature in September and October. When full grown, the maggots leave the fruit and enter the earth and form a cell an inch or less beneath the surface in which they pupate. The pupal stage extends over winter and until the following summer or fall. Occasionally, the pupal stage is assumed in the fruit or else beneath grass or other trash on the ground. Whenever this insect appears in a neighborhood, all fallen fruit in the neighborhood should be collected promptly and deeply buried or else fed to swine or cattle. If used for making cider, the pomace should be buried to insure the destruction of all maggots, even though it seems improbable that any would escape being crushed in passing through the mill. While keeping live stock in an orchard is not a commendable practice, pasturing hogs or sheep in an orchard infested with the railroad worm is a very convenient and sure method of disposing of the drops. Parings and apple refuse from the kitchen may be thrown to barnyard hens or covered with scalding water before being thrown out. Many pupae will be found in the bottoms of barrels, boxes, and bins where apples have been stored. As soon as these containers have been emptied, clean out all dirt, trash and fruit remnants and burn. Cultivation of the orchard in fall so as to turn up the pupae to winter weathering would doubtless assist in controlling the insect, but is an impracticable measure in some Ohio orchards and a doubtful proceeding in most. Spraying with arsenicals in early summer seems to be the most effective method of control. The adult insect is a two-winged fly, somewhat smaller

than the house fly, with a brownish head and prominent green eyes. The thorax is black and striped longitudinally with whitish lines. Perhaps the most obvious characteristic of the species is the four transverse blackish bars which cross each wing. The flies are to be found any time from July until killing frosts.

Minute black dots in more or less distinct depressions of malformed or knotty apples may be due to the work of the **Apple Seed Chalcis**, *Syntomaspis druparum*. A brownish line of hardened corky tissue may extend from the spot to the core, if this insect is responsible for the mark. Some of the sucking insects make very similar external marks upon the fruit. This insect infests the seed in the larval stage, the initial puncture having been made when the fruit was so small that the ovipostor of the female could reach through the pulp to the young seed. Some injury is done to the texture of the pulp and the seed will be of no use for planting. Wild crab-apples and seedlings seem most liable to attack. Destruction of all fallen fruit in the fall and of wild crabapple trees and seedling trees will control the insect whenever it becomes sufficiently important to justify such measures.

Some stage or other of the following insects may attract notice during September:

BAGWORM or BASKET WORM, *Thyridopteryx ephemeraeformis*. See page 110.

LEAF BLISTER MITE, *Eriophyes pyri*. See page 106.

CIGAR CASE BEARER, *Coleophora fletcherella*. See page 110.

PISTOL CASE BEARER, *Coleophora malivorella*. See page 110.

LEAF CRUMPLER, *Mineola indiginella*. See page 110.

TREE CRICKET, *Ecanthus* spp. See page 109.

WOOLLY APPLE LOUSE, *Schizoneura lanigera*. See page 105.

EUROPEAN GRAIN APHIS, *Aphis fitchii*. See page 109.

APPLE APHIS, *Aphis pomi*. See page 109.

ROSY APPLE APHIS, *Aphis sorbi*. See page 109.

APPLE TENT CATERPILLAR, *Malacosoma americana*. See page 109.

FOREST TENT CATERPILLAR, *Malacosoma disstria*. See page 109.

OCTOBER

The **Woolly Apple Aphis**, *Schizoneura lanigera*, gets its name from the whitish or greenish-white woolly substance which covers the body. These insects are not thus covered when young, but are like ordinary aphids and have a rusty brown color, the youngest ones being somewhat lighter. As they approach maturity, they become powdered over with a whitish coat, resembling a mildew, and gradually this waxy material lengthens into threads which make up the woolly covering. The lice which are seen latest in fall

are without this excresence, resembling other dusky-brown aphids. These lice are apt to collect in numbers in wounds, scars, crevices and cankers in the bark and are important agents in disseminating the fire-blight. Some of these woolly lice live on the roots. At all seasons of the year these root forms can be found in the earth, while others remain above ground in sheltered situations on the trunk and limbs. In late fall a large number move downward into the crevices of the bark about the crown. If a band of tree tanglefoot be put around the trunk of the tree in October it will catch many of these migrating aphids as well as the moths of the Fall Canker Worm, if any of the latter are present. Put a strip of paper or cloth around the trunk over a girdle of cheap cotton batting, and spread the tanglefoot over the band, especially if the trees are young. Tanglefoot, when in direct contact with the bark, sometimes does serious injury to young trees. Collar-rot or blight at the base of apple trees is very probably due, in many cases, to infection of this part of the tree by the aphids which migrate to the crown to pass the winter. A late fall spraying, after the leaves drop, with lime-sulfur or soluble oil will destroy most of those wintering above ground.

In late October, or in early November, may be found ascending apple trees, elms, hickories, basswood and other trees a spider-like creature much resembling the female moth of either the fall or the spring canker worm, but differently marked. The body is yellowish white. There are some black dots on the sides and along the back are two rows of black spots, a pair to each segment of the abdomen, except the last, which is marked with one only. The head is marked with black in front and the legs are ringed with black. Like the females of the canker worm moths, this one, the **Lime-tree Winter Moth**, *Erannis tiliaria*, is wingless, and the same methods of banding the trees with tanglefoot may be used to prevent her ascent (See page 108). The male moths are winged and have two transverse wavy brown lines across the buff-colored fore-wings. The hind wings are pale with a small brown dot in the middle of each. The males often fly in considerable numbers to street lamps in October and November.

The **Leaf Blister Mite**, *Eriophyes pyri*, causes severe damage to both apple and pear under some circumstances. In the fall, when the work of the mites is most conspicuous, small blister-like elevations or galls can be found on the leaves of both apple and pear. The blisters are quite red on pear foliage in the younger stages of infestation, but usually are less brilliant on the leaves of apple. The galls are more or less collected together along the borders of the leaves, leaving an irregular stripe of yellow along the midrib.

Later in the season, the blisters become brown, making thickened, deadened patches in the leaves. On the fruit and fruit stems, the blisters appear like pock marks, and are usually grouped about the blossom end of the apples. During October the mites leave the leaves and seek winter quarters beneath the bud scales and on the fuzzy bark of the new growth. Fifty or more of these mites may collect together under one bud scale. The second and third layers of scales are chiefly selected for such shelters. Spray infested trees once in October and once in November, or else make one spraying as soon as the majority of the leaves have fallen and defer the second until the following spring. Use kerosene emulsion diluted with five parts of water, or lime-sulfur at winter strength. Miscible oil, diluted with 12 to 15 parts of water, may be used. The oils, owing to their penetrating and creeping qualities, have some points of superiority over lime-sulphur for this use. Be sure that the buds and young limbs are thoroughly covered with spray.

Other insects which may attract notice in October:

European Grain Aphis, *Aphis fitchii*.. See page 109.

Apple Aphis, *Aphis pomi*. See page 109.

Rosy Apple Aphis, *Aphis sorbi*. See page 109.

Leaf Crumpler, *Mineola indiginella*. See page 110.

Resplendent Shield Bearer, *Coptodisca splendidiforella*. See page 111.

Hickory Tiger Moth, *Halesidota caryae*. See page 97.

Red Humped Caterpillar, *Schizura concinna*. See page 94.

Fruit Bark Beetle, *Scolytus rugulosus*. See page 123.

Grasshoppers. See page 58.

Blind-eyed Sphinx, *Paonias excaecatus*. See page 97.

Round Headed Borer, *Saperda candida*. See page 99.

Flat Headed Borer, *Chrysobothris femorata*. See page 99.

Apple Leaf Sewer, *Ancylis nubeculana*. See page 101.

White-dotted Apple Worm, *Balsa malana*. See page 101.

Apple Leaf Hopper, *Empoasca mali*. See page 101.

Ribbed Cocoon Maker, *Bucculatrix pomifoliella*. See page 103.

Apple Leaf Miner, *Tischeria malifoliella*. See page 103.

Apple Maggot or Apple Railroad Worm *Rhagoletis pomonella*. See page 104.

Apple Seed Chalcis, *Syntomaspis druparum*. See page 105.

NOVEMBER

Usually in November the wingless, spider-like females of the **Fall Canker Worm Moth**, *Alsophila pometaria*, crawl up the trunks of various trees, especially apple, and deposit their eggs on the bark and limbs. The female is between one-third and one-half of an inch

in length and light gray in color. The eggs are laid in clusters one end of each egg being attached to the bark, the other and outer end presenting a central puncture surrounded by a brown circle. These are gathered into masses of one hundred or more and adhere to each other by a gluey substance which cements their sides together. The males are provided with silky, gray wings, the front pair being crossed by two rather irregular whitish bands. The fore wings are brownish gray and the expanse is about one and one-third inch. These winged males may be seen flitting about in the woods, even after quite cold weather has set in. These insects issued mostly in the spring in northeastern Ohio in 1909 and in 1910, and this may be the rule in that section. In districts where they ascend the trees and lay their eggs in the fall, band the trees with tanglefoot or other sticky bands in early November. (See page 106; also Spring Manual, page 39, and Circular 65 of the Ohio Station.)

The **Scale insects** are quite amenable to fall treatment. As soon as the leaves drop in fall, spray for **San Jose Scale,** *Aspidiotus perniciosus*, with lime-sulfur wash or with miscible oil. Some entomologists believe that San Jose scale does as much or more damage during the winter months than in any other period of equal length during the year. Fall spraying, they think, largely prevents this excessive damage. In all cases of severe infestation, I would advise that a fall treatment be given and the application be repeated in the spring. Also, where orchards are extensive and help is scarce, it is advisable to get over as much of the orchard as possible in the fall. This fall spraying with lime-sulfur will also help to control **Scurfy Scale,** *Chionaspis furfurus*, and **Oyster Shell Scale,** *Lepidosaphes ulmi.* The caustic property of the wash weakens the shell which covers the eggs and, before spring, some of these scales crack and break, thus admitting the melting snows and rains of winter to dislodge the eggs and carry them to the ground. Instead of lime-sulfur, a coating of thick whitewash may be applied to the trunks and larger limbs for the two last named species of scales. When this dries and cracks, it will loosen the hold of the scales on the bark and thus admit the rain and melted snow beneath, thus making sure that many of the eggs will be carried to the ground. Miscible oil will creep under the scales and destroy quite a fraction of the eggs. Two other scales occasionally found on apple, which are more or less amenable to the same treatment, are **Forbes Scale,** *Aspidiotus forbesi* (see page 131) and **Putnam's Scale** or the **Eccentric Scale,** *Aspidiotus ancylus.*

The minute, ebony-black eggs of the various species of **Apple Aphids** are also destroyed to a limited extent by this fall spraying with miscible oil or with lime-sulfur solution.

Besides the **Woolly Apple louse**, there are three other species of aphids more or less common on apple. One of them is the **European Grain Aphis**, *Aphis fitchi.** This insect leaves the apple trees in July and migrates to fields of grain, rye, oats, wheat and grasses, these plants supporting them until autumn. Young fall wheat suffers quite seriously from their attacks. During September, October and November, migrating females fly back to the orchard from the grains and grasses, and lay their glossy, ebony-black eggs around the buds of the terminal shoots, and in crevices in the forks of the limbs, and under bark scales. Spraying, as soon as the leaves are down, with lime-sulfur solution or with an oil spray, such as kerosene emulsion or miscible oil, will kill quite a proportion of these eggs.

The **Apple Aphis** or *Aphis pomi** is found on apple throughout the entire year, not migrating to other plants. It begins laying winter eggs a little earlier than the preceding species. The eggs of the two species cannot be distinguished from each other and are laid in exactly the same situations. Remedies are the same for both species.

The **Rosy Apple Aphis**, *Aphis sorbi*,* is a migrating form, the winged females returning from other host plants in the fall and laying winter eggs of the same general appearance and in similar locations as the two foregoing species. Remedial measures the same as for the preceding.

Throughout the entire fall, the ring-like clusters of eggs of the **Apple Tent Caterpillar**, *Malacosoma americana*, and of the **Forest Tent Caterpillar**, *Malacosoma disstria*, encircle the limbs as described in the Winter Manual, page 14, and may be cut out and burned whenever noticed. Any systematic search for them will best be deferred until after the leaves have fallen.

Tree Crickets, *Ecanthus species*, occasionally injure apple trees by puncturing young twigs and inserting eggs in the punctures. These insects also eat holes into peaches, plums and other fruits, thereby providing entrance for the germs of rot and decay. See Raspberry Section, pages 146-147; also Winter Manual, page 34.

In late August and early September, an examination of the forks and the undersides of the branches of apple trees often reveals small, brownish, cigar-colored cases attached to the bark, a small caterpillar being sealed up inside. Fastened to the same branches may possibly be seen much longer cases fastened to the bark by their ends, each being colored red or reddish brown and shaped like a cigar. These

* The European Grain Aphis is the *Siphocoryne avenae* of some writers, *Aphis pomi=Aphis mali*, and *Aphis Sorbi=Aphis malifoliae*. For the present, I have thought it best to use the same names that were used in the Spring Manual. See Spring Manual, page 41.

longer cases are empty and were vacated by the moths of the **Cigar Case Bearer,** *Coleophora fletcherella,* in June and July. The progeny of these moths or young larvae cease to feed about the first week in September and go into winter quarters in the small resting cases mentioned, remaining dormant until the next spring. A lime-sulfur spray applied after the leaves fall will kill many of these larvae.

The young of the **Pistol Case Bearer,** *Coleophora malivorella,* go into hibernation at almost the same time as the cigar case worm. The winter resting case of the cigar case bearer is more nearly flat than is that of the one we are now considering; it is also smaller and of lighter color. The case of the first species is comparatively flattened and smooth and is curved into the shape of a half-moon, while that of the pistol case bearer is more like a rough tube, bent and shaped at the upper end so as to slightly resemble the handle of a miniature pistol. Also the cases of the pistol case bearer are usually anchored for the winter on the twigs and near the buds, while those of the other species are more apt to be collected in and about the larger forks. The young of both species hibernate over winter as larvae in their cases. A late spraying in the fall with lime-sulfur wash will kill a large fraction of these over-wintering larvae.

In late fall, after the leaves have dropped, there may be seen hanging from the twigs of apple and of many other fruit and shade trees, some curious, grayish, weather-beaten sacks of a tough, coarse, silken material, many leaf stems and fragments of leaves being woven loosely into the walls to conceal the true nature of this swinging basket, which was constructed in summer by the caterpillar of the **Bag-worm** or **Basket Worm,** *Thyridopteryx ephemeraeformis.* The baskets are from less than an inch to an inch and one-half wide and two or more inches long, and are securely fastened to the twigs by bands of silk. In fall, the baskets of the female moths are filled with soft eggs mixed in with fawn-colored, silky down. The cocoons which contain no eggs were formerly occupied by the males. It is advisable to gather the cocoons in the fall, wherever they are observed to be numerous, and burn, thus destroying the eggs which will otherwise hatch the following May. The caterpillars are pretty well grown in September and carry their baskets about with them as they feed on the foliage. If noticed at this time, the trees upon which they are located should be sprayed with arsenate of lead, four or five pounds in fifty gallons of water.

When the leaves have fallen from the apple and from various other trees, the nests of the **Leaf Crumpler,** *Mineola indiginella,*

are seen as described in the Winter Manual, page 17. The caterpillars hatch from the eggs in late summer and throughout the fall feed upon the foliage. These are about one-third grown when they construct their twisted, horn-shaped cases in which to pass the winter. They gnaw away some of the bark of the twigs in order to get suitable points for the attachment of their winter cases. The sprayings outlined in the general program for treatment of apple (Spring Manual, page 52) will generally keep this insect in perfect control. If an unusual outbreak should occur in the fall, of course an arsenical spray would destroy them. A treatment with lime-sulfur solution in late fall after most of the leaves have dropped would doubtless destroy many of them.

After the leaves drop in the fall, or before then, if one looks with sufficient care in the right place, little seed-like cases, pointed at both ends and less than one-eighth of an inch long, may be found attached to the bark of apple trees. In this little case can be found a small pupa, or earlier in the fall, a small larva. The case is enclosed in the epidermis of an apple leaf, for earlier in the season the larva worked as a miner in the tissue of the leaf between the two epidermal coverings. After becoming grown, it lined the mine with silk and then drawing the coverings together and fastening them on each side, it cut out the seed-shaped case. It wanders about for a time, protruding its head and thorax from the mouth of the pocket which it drags after it. After a while, the case is securely and permanently attached to the bark and the larva changes to a chrysalis, in which state it remains over winter. Spraying with the concentrated lime-sulfur wash after the falling of the leaves is quite efficient in destroying these insects in their cases. Owing to the shape of the pocket, which is like a miniature shield, and also to the brilliant coloration of the moth, which appears in May or June, the name of **Resplendent Shield-bearer** has been bestowed on this insect. Its scientific name is *Coptodisca splendoriferella.*

Clover Mite, *Bryobia pratensis.* See page 80. The minute, blood-red eggs, scattered over the bark, often attract attention.

SCHEDULE OF OPERATIONS FOR CONTROL OF AUTUMN INSECTS OF THE APPLE ORCHARD

1. The following apple insects which appear sometime in the fall are usually completely or partially controlled by the usual **mid-summer spraying** given for codling worm in late July or in early August. If, for any reason, this spraying was omitted, and if any of these listed insects become excessively injurious, a spraying with an arsenical poison may be made when they are observed:

YELLOW-NECKED DATANA, *Datana ministra.* See page 91.
UNICORN PROMINENT, *Schizura unicornis.* See page 94.
RED HUMPED CATERPILLAR, *Schizura concinna.* See page 94.
FALL WEBWORM *Hyphantria textor.* See page 94.
WHITE MARKED TUSSOCK MOTH, *Hemerocampa leucostigma.* See page 95.
HICKORY TIGER MOTH, *Halesidota caryae.* See page 97.
BLIND EYED SPHINX, *Paonias excaecatus.* See page 97.
APPLE LEAF SEWER, *Ancylis nubeculana.* See page 101.
WHITE DOTTED APPLE WORM, *Balsa malana.* See page 101.
RIBBED COCOON MAKER, *Bucculatrix pomifoliella.* See page 103.
BUD MOTH, *Tmetocera ocellana.* See page 103.
BAGWORM, *Thyridopteryx ephemeraeformis.* See page 110.
LEAF CRUMPLER, *Mineola indiginella.* See page 110.

2. **Spraying with lime-sulfur solution or miscible oil as soon as the leaves have all fallen** will be of use against:
BLISTER MITE, *Eriophyes pyri.* See page 106.
WOOLLY APPLE APHIS, *Schizoneura lanigera.* See page 105.

2. **Spraying with lime-sulfur solution or miscible oil as soon as the leaves have all fallen** is more or less useful against:
SAN JOSE SCALE, *Aspidiotus perniciosus.* See page 108.
SCURFY SCALE, *Chionaspis furfurus.* See page 108.
OYSTER SHELL SCALE, *Lepidosaphes ulmi.* See 108,
LEAF BLISTER MITE, *Eriophyes pyri.* See page 106.
WOOLLY APPLE APHIS, *Schizoneura lanigera.* See page 105.
EUROPEAN GRAIN APHIS, *Aphis fitchii.* See 109.
APPLE APHIS, *Aphis pomi.* See page 109.
ROSY APPLE APHIS, *Aphis sorbi.* See 109.
CIGAR CASE BEARER, *Coleophora fletcherella.* See pages 109-110.
PISTOL CASE BEARER, *Coleophora malivorella.* See page 110.
RESPLENDENT SHIELD BEARER, *Coptodisca splendoriferella.* See page 111.
LEAF CRUMPLER, *Mineola indiginella.* Lee pages 110-111.
CLOVER MITE, *Bryobia pratensis.* See pages 80, 111.
BUD WORM, *Tmetocera ocellana.* See page 103.

4. **Picking up and destroying fallen fruit soon after it is on the ground,** is important for control of:
CODLING WORM, *Carpocapsa pomonella.* See page 91.
PLUM CURCULIO, *Conotrachelus nenuphar.* See page 90.
APPLE MAGGOT or RAILROAD WORM, *Rhagoletis pomonella.* See page 104.
APPLE SEED CHALCIS, *Syntomaspis druparum.* See page 105.

5. **Clean culture or keeping weeds cut down all through the summer and fall** helps to control:
TREE CRICKETS, *Ecanthus,* spp. See page 109.

BUFFALO TREE HOPPER, *Ceresa bubalis*. See pages 95-96.

APPLE TREE HOPPER, *Empoasca mali*. See page 101.

6. **Raking together and burning fallen leaves** can sometimes be advantageously used against these:

APPLE LEAF SEWER, *Ancylis nubeculana*. See page 101.

WHITE DOTTED APPLE WORM, *Balsa malana*. See page 101.

APPLE LEAF MINER, *Tischeria malifoliella*. See page 103.

PLUM CURCULIO, *Conotrachelus nenuphar*. See page 90.

7. **Bands of tanglefoot or sticky material may be used for these**, putting the bands in place about October 1st:

FALL CANKER WORM, *Alsophila pometaria*. See pages 107-108.

LIME TREE WINTER MOTH, *Erannis tiliaria*. See page 106.

WOOLLY APPLE APHIS, *Schizoneura lanigera*. See page 105.

8. **When leaves have fallen cut out and burn twigs having eggs or punctures** of these:

BUFFALO TREE HOPPER, *Ceresa bubalis*. See pages 95-96.

Stictocephala inermis. See page 96.

TREE CRICKETS, *Ecanthus*, spp. See page 109.

APPLE TREE TENT CATERPILLAR, *Malacosoma americana*. See page 109.

FOREST TENT CATERPILLAR, *Malacosoma disstria*. See page 109.

9. **Look for borers, cut out and destroy** in September or early October. See page 99.

10. **Put on protectors from rabbits and mice in November or earlier.** White paint from uncooked linseed oil and pure white lead applied at this time protects from rodents and is said to give protection for the two succeeding summers against borers. See page 89.

11. Other insects to which attention may be drawn in November:

APPLE LEAF SEWER, *Ancylis nubeculana*. See page 101.
Collect fallen leaves and burn.

WHITE DOTTED APPLE WORM, *Balsa malana*. See page 101.
Collect fallen leaves and burn.

BUD MOTH, *Tmetocera ocellana*. See page 103.
Spray with lime-sulfur.

APPLE LEAF MINER, *Tischeria malifoliella*. See page 103.
Collect fallen leaves and burn.

RIBBED COCOON MAKER, *Bucculatrix pomifoliella*. See page 103.
Spray with lime-sulfur.

WOOLLY APPLE APHIS, *Schizoneura lanigera*. See page 105.
Spray with oil mixture or lime-sulfur and use tanglefoot bands.

LEAF BLISTER MITE, *Eriophyes pyri*. See page 106.
Spray with oil mixture or lime-sulfur solution.

PEAR INSECTS

SEPTEMBER

These insects, described and discussed in connection with other fruits, attack pear:

PLUM CURCULIO, *Conotrachelus nenuphar.* See page 90.

CODLING WORM, *Carpocapsa pomonella.* See page 91.

BUMBLE FLOWER BEETLE, *Euphoria inda.* See page 75.

FALL WEBWORM, *Hyphantria textor.* See page 94.

WHITE MARKED TUSSOCK MOTH, *Hemerocampa leucostigma.* See page 95.

ROUND HEADED APPLE TREE BORER, *Saperda candida.* See page 99.

FLAT HEADED APPLE TREE BORER, *Chrysobothris femorata.* See page 99.

FRUIT BARK BEETLE, *Scolytus rugulosus.* See page 123.

APPLE LEAF HOPPER, *Empoasca mali.* See page 101.

BUD MOTH, *Tmetocera ocellana.* See page 103.

LEAF BLISTER MITE, *Eriophyes pyri.* See page 106.

APHIDS. Use same remedies as for apple aphids. See page 109.

WOOLLY APHIS, *Schizoneura lanigera.* See page 105.

RED HUMPED CATERPILLAR, *Shizura concinna.* See page 94.

GRASSHOPPERS, See page 58; also Spring Manual, page 78.

BAGWORM or BASKET WORM, *Thyridopteryx ephemeraeformis.* See page 110.

The **Pear Psylla**, *Psylla pyricola*, is occasionally noticed in Ohio. The last or hibernating brood of insects appears in September, and all or nearly all of the nymphs of this brood have hatched before the last of the month. These hibernating adults are about one-third larger than the summer adults of earlier broods. They are blackish, jumping plant lice, about one-tenth of an inch long and resemble miniature cicadas. When first hatched, the nymph is a very minute, louse-like insect, translucent yellow in color. The full grown nymphs are oval in contour with two pairs of black wing-pads. The general color is blackish, tinged with red; the eyes are bright crimson. The nymphs cluster on the leaf-petioles and on the stems of the fruit. They also are found along the midrib on the undersides of the leaves. They excrete great quantities of honey-dew, and in this flourishes a black, sooty mold, giving the trees a most dirty, unhealthy appearance. The adults feed almost anywhere. The fall brood of adults creep into crevices of the bark of pear trees in late fall, and there remain until the following April, when they resume activity. Spraying with a miscible oil or with lime-sulfur spray as soon as the leaves drop will destroy many of these.

Throughout all of the autumn months, lepidopterous borer may be found working in the bark of pear and sometimes in that of apple trees. Its presence is indicated by castings, resembling fine sawdust, thrown out upon the bark of the tree. The larva is whitish to pink, and does most of its feeding under and in the bark, injuring the sapwood but little. The adult is a clear-winged moth, having a wing-expanse of about three-fourths of an inch and a pair of yellow bars crossing the abdomen transversely; a fan-shaped tuft of hairs at the end of the abdomen is of the same color. It appears in summer and deposits the eggs for the worms which appear in early fall. It is known as the **Apple** or **Pear Sesian**, *Sesia pyri*. The most satisfactory method of destroying the worms is to dig them out and kill them. Whitewashing or painting properly (See page 123) the trunks of the trees in early summer is probably of some value in discouraging egg-laying.

The **Pear Leaf Miner** *Ornix geminatella*, is a very small, dark, steel-gray moth, expanding about one-third of an inch. The larva mines in the leaf tissues of both apple and pear. It sometimes draws two leaves together, tying them with silken fibers; again, it may fold up in a single leaf. Since it passes the winter inside the fallen leaves, as a larva, or as a pupa, its numbers can be thinned, if it should become numerous, by collecting and burning the leaves soon after they drop in autumn.

Quite rarely the **Pigeon Tremex** or **Horn-tail**, *Tremex columba*, attacks the pear. This is an elongated, hard-bodied, hymenopterous insect with a stiff, horn-like ovipositor which is used to thrust the eggs a half inch or thereabouts into the wood, where they hatch into larvae, these becoming long white cylindrical worms, having six feet at the head end of the body and a sharp horny tail at the other end. When full grown, the larva is over two inches in length. The adults appear during August, September and October, and during these months may often be found stuck fast to the tree trunks in which they have laid their eggs, being unabe to extricate their ovipositors. They prefer trees that are in some stage of decay for oviposition, and are most frequently found attacking shade trees like the maple, elm, oak and sycamore, but the pear and apple are occasionally attacked. Since the boring is almost wholly confined to the heartwood, not so much damage is done by these borers as by some other species which work in the cambium or growing wood. Trees containing excessive numbers of the larvae should be cut down and burned or otherwise disposed of so as to destroy the larvae. All trees should be kept in thrifty growing condition so as to lessen the likelihood of attack.

One of the shot-hole borers, a near relative of *Scolytus rugulosus*, but known as the **Pear Blight Beetle**, *Xyleborus dispar*, is at times injurious to pear, apple, plum, cherry and several kinds of forest trees. While the blighting effects of its work are most conspicuous in mid-summer, it is in evidence in some stage of existence in winter, and its injuries may be noticed in fall and winter. It partially girdles young trees, sometimes before they leave the nursery, thus causing the death of the upper parts. It tunnels into the trunks of older trees and hollows out the pith and centers of small twigs. The openings into the burrows are small and circular, as is usual with the shot-hole borers. The life-cycle in America has not been very thoroughly worked out, but the data gathered indicate the probability of finding the adult beetles packed in the tunnels, end to end, forming a continuous line in the fall and winter months. The eggs for a second generation are probably laid in August and September, the larvae being found in the fall and winter, feeding together with the adults on a fungoid growth which lines the tunnels, and which is carefully propagated under the intelligent supervision of the insects. The tunnel made by this borer is first toward the center, then a horizontal gallery is made running part way around the trunk or branch, and at right angles to this, a large number of galleries are excavated, running up and down the stem. The beetle is pitchy brown to black in color, the wing-covers inclining to reddish brown. The female is about one-eighth of an inch long, the male considerably smaller. Badly infested trees should be cut and burned in fall. Healthy trees should be kept thrifty and whitewashed or kept covered with a carbolized soap-paint to repel the beetles and prevent egg-laying (See page 123).

In late August, during early September, and sometimes yet later in the season, the slimy slugs of the **Pear Sawfly**, *Eriocampoides limacina*, commonly known as the **Pear Slug**, may be found upon the foliage of pear and cherry, eating away the pulp of the leaves from one side, leaving nothing but the veins and epidermis of the opposite side. These slugs, which are somewhat enlarged at the anterior or head end of the body, descend to the ground when full fed and make their cocoons in the upper layer of soil, rarely going more than one-half inch below the surface. The best remedy is to spray with an arsenical solution when they are feeding, or a decoction of hellebore may be used. In case a very few trees are attacked, the top three inches of soil may be lifted and burned or subjected to a high temperature in late fall, thus preventing a recurrence of the pest the following year. If this is done, the excavated soil should be replaced and covered with a straw mulch to safeguard the trees against winter killing.

OCTOBER

WOOLLY APPLE APHIS, *Schizoneura lanigera*. See page 105.
LEAF BLISTER MITE, *Eriophyes pyri*. See page 106.
LEAF CRUMPLER, *Mineola indiginella*. See page 110.
RED HUMPED CATERPILLAR, *Schizura concinna*. See page 94.
GRASSHOPPERS. See page 58.
ROUND HEADED BORER, *Saperda candida*. See page 99.
FLAT HEADED BORER, *Chrysobothris femorata*. See page 99.
FRUIT BARK BEETLE, *Scolytus rugulosus*. See page 123.
APPLE LEAF HOPPER, *Empoasca mali*. See page 101.

NOVEMBER

Nearly all of the species listed for October.
SAN JOSE SCALE, *Aspidiotus perniciosus*. See page 108.
OYSTER SHELL SCALE, *Lepidosaphes ulmi*. See page 108.
SCURFY SCALE, *Chionaspis furfurus*. See page 108.
WOOLLY APPLE APHIS, *Schizoneura lanigera*. See page 105.
APHIDS. See page 108 for methods of destroying eggs; also see page 105.
BUD MOTH, *Tmetocera ocellana*. See page 103.
BAG WORM or BASKET WORM, *Thyridopteryx ephemeraeformis*. See page 110.
QUINCE CURCULIO, *Conotrachelus crategi*. See page 132.
WHITE MARKED TUSSOCK MOTH, *Hemerocampa leucostigma*. See page 95.
TREE CRICKETS, *Ecanthus* spp. See page 109.
FALL CANKER WORM, *Alsophila pometaria*. See page 102.
APPLE TREE TENT CATERPILLAR, *Malacosoma americana*. See page 109.
CIGAR CASE BEARER, *Coleophora fletcherella*. See page 110.
PISTOL CASE BEARER, *Coleophora malivorella*. See page 110.
CLOVER MITE, *Bryobia pratensis*. See page 111.

Schedule of Fall Operations for Pear is practically the same as for apple (See page 111). Cultivation of the pear orchard is to be discouraged except in case of great necessity, since it stimulates rapid growth and, therefore, invites blight.

PLUM INSECTS

SEPTEMBER

PLUM CURCULIO, *Conotrachelus nenuphar*. See page 90.
CODLING WORM, *Carpocapsa pomonella*. See page 91. Rarely occurs on plum and needs no remedial attention.
BUFFALO TREE HOPPERS, *Ceresa bubalis*, *C. taurina*, et al. See pages 95-96.

FLAT HEADED APPLE TREE BORER, *Chrysobothris femorata.* See page 99.

FALL WEBWORM, *Hyphantria textor.* See page 94.

WHITE MARKED TUSSOCK MOTH, *Hemerocampa leucostigma.* See page 95.

PEAR SLUG, *Eriocampoides limacina.* See page 116.

UNICORN PROMINENT, *Schizura unicornis.* See page 94.

BLIND EYED SPHINX, *Paonias excaecatus.* See page 97.

BUD MOTH, *Tmetocera ocellana.* See page 103.

CHERRY LEAF BEETLE, *Galerucella cavicollis.* See page 129.

PEAR BLIGHT BEETLE, *Xyleborus dispar.* See page 116.

FRUIT TREE BARK BEETLE or SHOT HOLE BORER, *Scolytus rugulosus.* See page 123.

PEACH BARK BEETLE, *Phloeotribus liminaris.* See page 125.

Holes eaten through the skins of the ripening fruits may have been made by **Tree Crickets**, *Ecanthus* spp., or started by wasps and bees. The tree crickets make their incisions at night. They also cause injury by puncturing small twigs when laying their eggs. See page 109.

During late August and in early September, plums are sometimes found falling as if stung by Curculio, but investigation discloses that the pit has been eaten out and that no crescent-shaped cut is shown on the skin of the fruit. Soon after the fruit falls, a small, mottled, brown snout beetle eats its way out through the side of the fruit, making a rather large, circular hole. This insect is the **Plum Gouger**, *Coccotorus prunicida.* It is slightly larger than the plum curculio, lacks the warts or humps of the latter on the wing covers, and has many short, whitish hairs which give it a pruinose or light-colored, dusty appearance. Until it escapes from the fruit, there is generally no indication of its presence, except possibly a small scar from which the gum exudes. Occasionally a malformed fruit indicates its presence. The pupal stage is passed in the pit and the fruit seldom falls until the beetle is just ready to escape. By far the most effective remedy is to pick and destroy the infested fruit as fast as it falls, because spring spraying is not very successful. Hogs running in the plum orchard do the work very well, but where these animals are not available or are objectionable, pick up the fruit by hand and feed to hogs, or burn or bury fully two feet deep. The beetle hibernates over winter. This insect is quite injurious in the states further west, but so far as known, it causes little or no damage in Ohio.

The caterpillars of the **Gray Dagger Moth**, *Apatela interrupta*, are often found upon plum foliage in early September. The caterpillars reach full growth about the middle of September and are

then about one and one-half inches long. The large, black head is marked with yellowish dots at the sides. The bluish-gray color of the back is divided by a wide, slate-colored band down the central area, and in the middle of this is a pale orange-yellow line from the second to the fifth segment; back of this line commence a series of spot groupings extending to the eleventh segment inclusive. Each group consists of four spots, two of them orange-yellow, arranged longitudinally, and two of them are metallic-green, arranged transversely, all four being set in a circle of deep velvety black. Two cream-colored stripes extend along the sides, nearly vanishing at each extremity, and into these from each of the black, velvety spots on the back, bends a short, black line with a yellowish spot back of its base. Dull, ochrey spots mark the sides, and on top of the twelfth segment there is a prominent black hump. Sparse whitish hairs cover the body, being most numerous on the sides. The underside of the body is dull-greenish, and the feet are black. About the middle of September, these caterpillars, of the second brood, spin slight cocoons in any sheltered spot and transform to chrysalids in which state they spend the winter. If numerous enough to require attention, spray with powdered hellebore, or else with Paris green, 1 lb. in 100 gallons of water. Use the milk of lime from two or three lbs. of freshly slaked stone lime in the Paris green mixture, to prevent burning of the leaves. Arsenate of lead should be used instead of Paris green on trees that are not carrying fruit.

The caterpillars of the **Mottled Plum-tree Moth**, *Apatela superans*, also reach maturity about the middle of September, enter the chrysalis stage, and thus pass the winter. This is a green caterpillar, about an inch long, and is somewhat flattened vertically as if the sides had been compressed. There is a chestnut-colored stripe along the back, margined with yellowish, and on all the segments are shining tubercles, each giving rise to one or more blackish hairs. A few whitish hairs are found on the sides of the body. Remedy same as for the preceding species.

Occasionally the larva of the **Viceroy Butterfly**, *Limenitis archippus*, is found feeding on plum leaves, though its normal food is the willow. The larva occurs from the latter part of September until the leaves drop. The winter is passed in a half-grown state, protected by a rolled-up leaf attached to the twig on which the caterpillar fed. The young larva is yellowish-brown, mottled with dark streaks, especially below the stigmata or breathing pores. Each joint is divided by a transverse, impressed line, and on top of the folds, thus made, are four elevated spots, the front ones largest. A

little later the horns acquire their mature proportions and the surface of the larva becomes more granulated. When full grown, the larva is about 1.2 inches long, and of a whitish or olive-green color. Head, dull olive, with dense, minute prickles. Upon the top of the head is a pair of two-pronged, prickly horns. Back, specked and mottled with various shades of olive and a white, lateral line beneath spiracles. Some elevated blue dots on joints 4-8 and 10-12. A pair of prickly, black horns 1-6 inch long on top of joint 3. On joint 13 there are four black, prickly horns, and many other prickles and tubercles, some of the latter being yellow, scattered over the body. This species is not apt to become sufficiently injurious to require special attention. Hand-picking and spraying with poison can be resorted to if necessary. The hibernating larvae are easily discovered after the leaves drop and can be collected by hand and burned.

In early September, a very large, pea-green caterpillar over three inches long is sometimes found feeding on plum. The head is dull brick-red, and the anal or posterior plate is margined with purplish-brown, this colored band taking a V-shape. There are seven oblique, pale, yellowish lines on each side of the body. Each segment is ornamented with six tubercles, reddish-brown in color, silvered at the bases, and ornamented at the tips with white hairs. The spiracles or breathing pores are delicate salmon-yellow and the thoracic shield, just behind the head, may be margined along the front with yellowish-green. Sometime in September, the caterpillar draws together some of the leaves from the tree on which it has been feeding, and with them makes the exterior walls of its oval, coarse, silken cocoon. The silk of the cocoon is silvery brownish-white in color, and the insect constructing it is known as the **American Silk Worm**, *Telea polyphemus*. The cocoon generally falls to the ground with the leaves and the winter is passed as a chrysalid. No other remedy than hand picking is likely to be needed. Gathering and burning the cocoons after the leaves drop can be resorted to if necessary, and the caterpillars are susceptible to arsenical poisoning.

During September, an occasional larva of the **Waved Lagoa or Urn Maker**, *Lagoa crispata*, is found feeding on plum leaves. This is a singular larva, nearly oval, covered above with brownish, evenly-shorn hairs which are raised to a ridge along the middle of the back and sloped off roof-like on each side. When grown, it constructs an urn-shaped cocoon which is fastened to the side of a twig, and in this it transforms to a chrysalis, in which state it remains until the following summer. This cocoon is a curious object made of hardened,

grayish, tough silk and is neatly covered with a flat, hinged, circular lid which is lifted when the moth escapes. It is chiefly an object of curiosity and not of much economic importance.

OCTOBER

PEACH BORER, *Sanninoidea exitiosa*. See page 126.

LESSER PEACH BORER, *Sesia pictipes*. See page 126.

BLIND EYED SPHINX, *Paonias excaecatus*. See page 97.

PEACH TWIG BORER, *Anarsia lineatella*. See page 127.

NOVEMBER

LEAF CRUMPLER, *Mineola indiginella*. See page 110.

BUD MOTH, *Tmetocera ocellana*. See page 103.

TREE CRICKETS, *Ecanthus spp*. See page 109.

BAGWORM or BASKET WORM, *Thyridopteryx ephemeraeformis*. See page 110.

FALL CANKER WORM, *Alsophila pometaria*. See page 102.

APPLE TREE TENT CATERPILLAR, *Malacosoma americana*. See page 109.

FOREST TENT CATERPILLAR, *Malacosoma disstria*. See page 109.

SAN JOSE SCALE, *Aspidiotus perniciosus*. See page 108.

OYSTER SHELL SCALE, *Lepidosaphes ulmi*. See page 108.

SCURFY SCALE, *Chianaspis furfurus*. See page 108.

FORBES SCALE, *Aspidiotus forbesi*. See page 131.

The **European Fruit Scale**, *Aspidiotus ostraeformis*, very much resembles San Jose Scale in external appearance and the two cannot be distinguished with certainity except by examination with a good microscope. It seldom crusts over the bark to such an extent as San Jose Scale and shows a marked preference for plum before all other orchard fruits. Plum trees are occasionally killed by it. Treatment is exactly the same as for San Jose Scale. See page 108.

The **European Fruit Lecanium**, *Lecanium corni*, is the commonest soft scale on plum. *Lecanium prunastri* may also occur in Ohio. Treatment same as for Terrapin Scale. See page 128.

The **Plum Gall Mite**, *Eriophyes phloeocaptes*, a microscopic mite, forms a multitude of small, light-colored, blister-like galls at the base of the buds. A cluster of these galls looks like an aggregation of minute buds, often sufficiently numerous to surround the twig. Hibernation takes place in these and possibly beneath the bud-scales to a certain extent. Though supposed to be an imported species, it may be a native, since the recorded habits of the European insect bearing this name do not seem to agree with those of the American form. If, as in Europe, hibernation takes place to any considerable extent beneath the bud-scales, spraying with the lime-sulfur wash shortly before the dropping of the leaves would seem

to promise something worth while and spraying with kerosene emulsion or a miscible oil after the leaves were shed might prove of value. My observations confirm the statement of Mr. Nathan Banks that they hibernate in the galls, for they are found there in great numbers in winter, but I have not looked beneath the bud-scales for them during the same season. Careful pruning and burning of the infested twigs during the dormant period is the most promising remedy.

The minute, glossy, jet black eggs of the **Hop Louse**, *Phorodon humuli*, and of one or two other species of plant lice may be found on the twigs in winter, and are likely to be specially clustered in the forks of the smaller limbs and twigs. Spraying with soluble oil or lime-sulfur solution during the dormant season kills a considerable fraction of these eggs. This insect is sometimes a very serious pest.

CLOVER MITE, *Bryobia pratensis*, see page 80.

SUMMARY OF FALL OPERATIONS FOR THE PLUM ORCHARD

1. **Cultivation** in early September may destroy a considerable number of Curculio pupae.

2. **Whitewashing** in early September may be necessary to protect against the **Shot Hole Borer** and the **Peach Bark Beetle.**

3. **Picking up and destroying** the fallen fruit, or pasturing hogs in the orchard so they may devour the fruit as fast as it falls, is of use in suppressing the **Curculio** and the **Plum Gouger.**

4. Where **caterpillars** are feeding on foliage, **spray with hellebore or Paris green** if fruit is on the trees. Paris green should be used not later than three or four weeks before picking. Arsenate of lead is best for all trees not in fruit.

5. **Keeping weeds and undergrowth** in and near the orchard closely mown will reduce injury by the **Tree Hoppers** and **Tree Crickets.**

6. **Banding with tanglefoot** about the first of October will prevent the ascent of the **Fall Canker Worm.**

7. **Spraying with lime-sulfur or miscible oil** after the leaves drop is useful for control of **San Jose Scale, European Fruit Scale, Forbes Scale, Oyster Shell Scale, Scurfy Scale, Plum Gall Mite, Clover Mite, Bud Moth** and eggs of **Aphids.**

8. **Spraying with strong kerosene emulsion or soluble oil while trees are dormant** is useful against the **Soft Scales.**

9. **Pruning and hand collecting** should be resorted to after falling of the leaves for the **Plum Gall Mite, Viceroy Butterfly, Bagworm, American Silk Worm, Flat Headed Apple Tree Borer,** eggs of the **Tent Caterpillars, Peach Borer, Lesser Peach Borer,** and eggs of **Tree Hoppers** and of **Tree Crickets.**

PEACH INSECTS

SEPTEMBER

PLUM CURCULIO, *Conotrachelus nenuphar*. See page 90.

CODLING WORM, *Carpocapsa pomonella*. See page 91. Occurs so rarely on peach that it needs no economic attention under ordinary conditions.

BUFFALO TREE HOPPERS, *Ceresa bubalis* et. al. See pages 95-96.

FLAT HEADED APPLE TREE BORER, *Chrysobothris femorata*. See page 99.

DIVARICATE BUPRESTID, *Dicerca divaricata*. See page 130.

WHITE DOTTED APPLE WORM, *Balsa malana*. See page 101.

CHERRY LEAF B. .TLE, *Galerucella cavicollis*. See page 129.

BUMBLE FLOWER BEETLE, *Euphoria inda*. See page 75.

STALK BORER, *Papaipema nitela*. See page 62. No damage to attract attention is done at this season by the Stalk Borer, but to prevent the moths from depositing their eggs, where they will eventually develop in the normal manner, all weedy growth in and about the orchard should be kept mown close.

FALL WEBWORM, *Hyphantria textor*. See page 94.

WHITE MARKED TUSSOCK MOTH, *Hemerocampa leucostigma*. See page 95.

The **Shot Hole Borer**, *Scolytus rugulosus*, is present in all stages on various fruit trees in the early part of September. The last beetles of the second generation disappear, generally speaking, about the middle of this month. An illustration of the engraving work or galleries made under the bark by this species is shown on Plate X. Small, round holes in the bark and masses of exuding gum indicate that this beetle or some not distant relative is at work. The eggs for the second generation are scattered through the months of July, August and September, being laid by preference on trees that are unhealthy or weak. There appears to be in some seasons a sort of massing of the number of beetles in early September, more appearing at that time than in the earlier months of summer, and, therefore, a heavy coat of whitewash applied to threatened orchards about the first of September is advised. Add one-fourth pound common salt to each pail of whitewash to increase its sticking qualities and apply with a broom. Thin whitewash may be applied with a spray pump, but it requires several applications, repeated at short intervals, to fill the irregularities in the bark and thus embarrass the beetles in finding suitable places for commencing their burrows. Some growers prefer using a carbolic emulsion, such as a 12 percent emulsion of Carbolineum avenarius, which is more effective than whitewash in repelling the beetles, but less safe for the trees. Four pounds of naptha soap is dissolved in four gallons of

boiling water and one gallon of Carbolineum avenarius is emulsified with it by means of a force pump, the method of mixing being the same as for kerosene emulsion. Three gallons of water are added for use and the mixture is applied with a spray pump. Protect the hands and face from this spray, as it is very blistering in its effects. Horses hitched to the spray wagon should be well blanketed to keep it off from them. Badly infested trees may be cut down in the fall and winter and burned to prevent a spring brood of the beetles from developing.

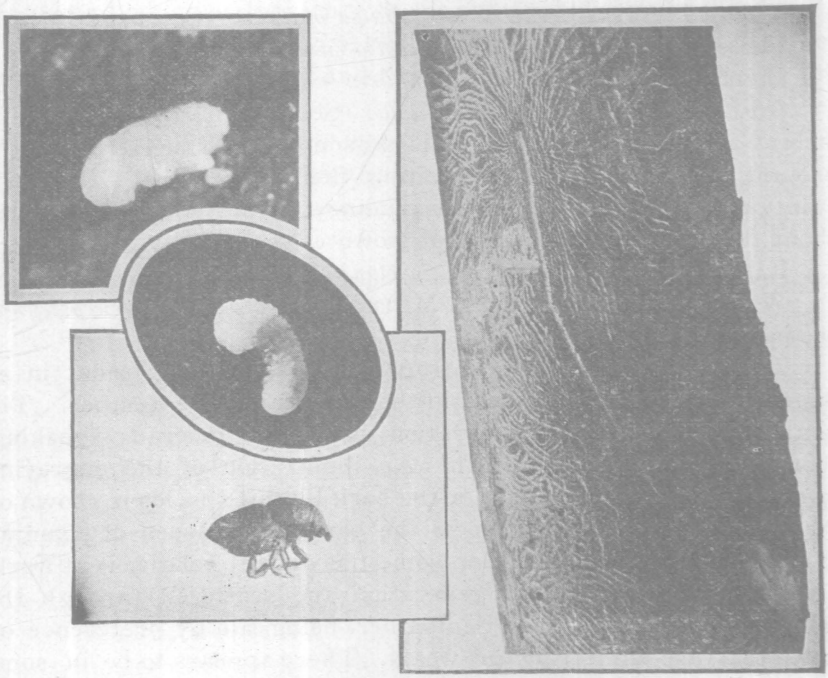


Plate X.

Shot Hole Borer, *Scolytus rugulosus*, and its work.
Adult beetle, larva in the oval, pupa in square, specimen of engraving work on wood from which bark has been stripped.

The shot-hole beetle is about one-tenth of an inch long and one-third as wide, nearly black, except the tips of the wing covers and lower part of the legs, which are russet-red. The wing covers are minutely grooved as seen through a lens, and both wing covers and thorax are minutely punctured. The head is vertical and the antennae, or feelers, short and strongly clubbed at the outer end. The larva or grub is about one-tenth inch long, white, footless, and transversely wrinkled.

The Peach Bark Beetle, *Phloeotribus liminaris*, is quite similar in appearance and habits to the preceding species. This insect is slightly smaller than the shot-hole borer, being slightly less than one-eleventh of an inch long and more slender in appearance. In color, it varies from light brown to almost black. The opening to the burrow of *P. liminaris* is partly filled or covered over because the exudation is held together by a fine silken web, which is not found at the mouth of the burrows of *S. rugulosus*. A few of the adults of the summer brood may linger until early September, but most are gone by late August. The fall brood come forth in late September and during October, and probably into November. They weaken healthy trees in the fall by making feeding burrows into the bark, from each of which a little wax will exude the following summer. In time, healthy trees may become sufficiently weakened to render them attractive as a breeding ground for various forms of bark beetles. The insects hibernate over winter in burrows drilled into the bark. Treatment same as for the common shot-hole borer, applied at the same date.

The Striped Peach Worm, *Gelechia confusella*, recorded as doing serious damage in Michigan, will doubtless be heard from sooner or later in Ohio. The larva is described as "dirty white with six longitudinal, reddish-brown stripes, and with a yellowish-brown head and thorax. It wriggles violently when disturbed. It binds together the leaves with a web of fine silk, forming a nest of loosely bound leaves in which several larvae live and in which they change to pupae." The caterpillars of the fall generation appear about the middle of September, reach their growth before the leaves drop, and transform to pupae, in which state they pass the winter. Either cut out and burn the nests, or, in case of early varieties, from which the fruit has already been picked, spray with arsenate of lead, just as the worms appear.

The Green Stink Bug of the Peach, *Nezara hilaris*, sometimes does great injury to the fruit of the peach, not only in Georgia, but also in Ohio. It is also a great nuisance in the orange groves of Florida, causing the fruit to fall because of its punctures. It has sometimes caused a loss of approximately $750.00 to the peach crop in orchards of less than 20 acres in Northern Ohio. The damage commences in early summer when the young nymphs thrust their sucking, needle-like beaks into the young fruit to imbibe the sap. Damage is continued until late in the fall. The fruits become rough and knotty, somewhat shriveled, flecked over with drops of exuding gum, and the pulp is hardened along the line of puncture. The injured fruit is quite persistent to the tree and does not drop. The

development of the insect in excessive numbers seems to depend upon some climatic factor, possibly a succession of dry seasons. With average conditions, it attracts comparatively little attention. Not enough is known of its life-history and habits to warrant specific recommendations. There are some grounds for believing that dense cover crops in the orchard encourage its multiplication.

OCTOBER OR NOVEMBER

Several of the species placed at the head of the September list can just as well be taken care of in October as in September.

The larvae of the **Peach Borer**, *Sanninoidea exitiosa*, are found in the fall in various stages of growth, the latest laid eggs of the season being deposited in early September. Sometime in October or early November, remove the earth from around the bases of the trees to a depth of 6 to 8 inches or more and examine all wounds and patches from which gum is found to be exuding. A small, stiff, coarse brush will be useful in removing the gum and crushing such larvae as are feeding on the surface. With a stout, sharp knife, cut longitudinally, or with the grain of the wood, into cavities, and with a longer, more slender blade or with a wire, probe into all channels and burrows. If a borer can be located in the burrow, a straight thrust so as to hit the borer is all that is necessary, and as little cutting as possible should be done in any case. Wherever exuding gum is noticed, especially if mixed with chips, a careful examination should be made. Larvae in closed burrows, or nearly closed, can generally be destroyed without much cutting by removing the gum from the mouth of the opening, then inserting and twisting about a wire probe, so as to loosen the gum deposit, and injecting some bisulfid of carbon from a spring bottom oil can, the opening being at once closed with a plaster of stiff mud, with putty, grafting wax, or waxed disks of tough paper. Mound the trees slightly when replacing the earth, so as to give some winter protection to the roots and to bring the fresh earth against wounds, cuts and scraped surfaces.

When "worming" for the peach borer, attention is likely to be drawn to exudations of gum high up on the trunk and even on the limbs of peach trees, mixed with the frass or chips of a lepidopterous borer, quite like the ordinary peach borer in appearance. This borer, known as the **Lesser Peach Borer**, *Sesia pictipes*, makes long, irregular burrows, generally following the outline of wounds or along the edges of cracked bark. They may be found, however, in the same situation as the ordinary and larger peach borer; also are apt to be numerous in the forks and crotches of the larger branches. Scores of specimens can often be found on single trees,

in which case the exudations of gum will take on something of the general appearance of bark beetle infestation. It is one of the commonest of Ohio peach insects and is probably responsible for as much injury as any other species. It appears probable that some eggs are laid in September in this state, but the majority of over-wintering larvae are supposed to be from eggs laid during June and July. These larvae are of a creamy white color, and are smaller than those of the better known species. The soft, pliable, yellowish-brown cocoons are constructed in the burrows under the bark, but, when old, are dark brown and brittle.

This insect masses on old, neglected and weakened trees, hence the need of keeping the orchard in good, vigorous health, and the bark smooth and clean, free from mechanical injuries, and all crevices filled with whitewash. Cut out and destroy the larvae in the same manner as for the peach borer, cleaning out and painting the wounds with Bordeaux mixture or lime-sulfur solution. In case of large orchards, some of this work must be attended to in the fall, but is best deferred until spring, whenever possible.

The **Peach Twig Borer**, *Anarsia lineatella*, occurs in late fall as a small larva and attracts some attention because of its habit of eating small cavities in the bark at the crotches of the smaller twigs or branches, by preference into those on the inner portions of the tree. The larvae are about one-eighth inch long, and a little pellet of frass covers over each of the openings to their silken-lined burrows. Under ordinary conditions, no remedial attention is needed for these fall caterpillars, but if abnormally abundant and threatening, many can probably be killed in their burrows by spraying with kerosene emulsion or with a miscible oil. Lime-sulfur sprays, at this time, are probably of some value, but can hardly equal the oils so far as reaching this hibernating larva is concerned.

NOVEMBER

TREE CRICKETS, *Ecanthus* spp. See page 109.

BAGWORM or BASKET WORM, *Thyridopteryx ephemeraeformis.* See page 110.

LEAF CRUMPLER, *Mineola indiginella.* See page 110.

FALL CANKER WORM, *Alsophila pometaria.* See page 107. Not often serious on peach and generally needs no attention.

APPLE TREE TENT CATERPILLAR, *Malacosoma americana.* See page 109.

FOREST TENT CATERPILLAR, *Malacosoma disstria.* See page 109.

SAN JOSE SCALE, *Aspidiotus perniciosus.* See page 108.

The fungicidal effect of lime-sulfur, applied in the fall, is not so good upon peach as when it is applied early in the spring, but it is about equally good as a scale destroyer, and some entomologists think better.

ECCENTRIC SCALE or PUTNAM'S SCALE, *Aspidiotus ancylus*. See page 108.

WALNUT SCALE or GOPHER SCALE, *Aspidiotus juglans-regiae*. See Spring Manual, page 62.

Treatment for both the above named species same as for San Jose Scale.

TERRAPIN SCALE, *Eulecanium nigrofasciatum*. (For description, see Spring Manual, page 58).

Spray with kerosene emulsion diluted with 6 or 7 parts of water, or with a miscible oil diluted with 12 to 15 parts of water. Trees or branches very badly infested may be given a treatment of pure crude oil, since in this case one is practically obliged to adopt a "kill or cure" policy. When it is possible to do so, defer these strong oil treatments until the buds are swelling in spring; this is the safest period to make them, but undiluted oils are never wholly safe. Lime-sulfur spray during the dormant period has practically no effect on this insect. So far as possible, prune out and burn badly infested limbs.

SOFT SCALES or EULECANIUMS, several species. Treatment same as for Terrapin Scale.

Spraying with either lime-sulfur solution or miscible oil will destroy a good many aphid eggs; also eggs of the CLOVER MITE, *Bryobia pratensis*. See page 80.

SUMMARY OF FALL OPERATIONS IN THE PEACH ORCHARD

1. Cultivation during the first few days of September will destroy some Curculios and also bury many weeds which are used for egg-laying purposes by the parent moth of the Stalk Borer.

2. Keeping the weeds mown close will help to prevent injury by Tree Crickets and Tree Hoppers.

3. Whitewashing the trunks and larger limbs in early September gives a good measure of protection against the Shot Hole Borer, the Peach Bark Beetle and other bark borers.

4. The process of "worming" or cutting out and destroying borers should be used in October or November against the Peach Borer, the Flat Headed Apple Tree Borer and the Divaricate Buprestid. Injections of bisulfid of carbon are helpful against

these borers when in closed burrows. The same measures may be used against the Lesser Peach Borer, but if the size of the orchard will permit, the work is best postponed until spring.

5. Spraying with arsenate of lead may be useful at times against Fall Webworm, White Marked Tussock Moth, White Dotted Apple Worm and Striped Peach Worm.

6. Hand gathering of worms can be profitably used against the Striped Peach Worm and the Fall Webworm.

7. Spraying after the leaves drop with kerosene emulsion or soluble oil is useful against the Terrapin and other Soft Scales and the Peach Twig Borer; the same application destroys a fair percentage of Aphid eggs.

8. Spraying with lime sulfur wash after the leaves drop is advised for the San Jose, Walnut and Eccentric or Putnam's Scales; this application is also of some use in destroying eggs both of Aphids and of the Clover Mite.

9. In case of Fall Canker Worm becoming numerous, which is very improbable in a cultivated peach orchard, band with tree tanglefoot, or its equivalent, about the middle of October.

10. Close inspection, hand gathering and trimming after the leaves have fallen, may remove the eggs of the Basket Worm, Apple Tent Caterpillar, Forest Tent Caterpillar, Fall Canker Worm, Tree Crickets and Buffalo Tree Hoppers.

CHERRY INSECTS

SEPTEMBER

Plum Curculio, *Conotrachelus nenuphar.* See page 90.

Plowing to destroy the Curculio in late summer or early fall will also be useful, in all probability, for the destruction of pupae of the **Cherry Fruit Fly,** *Rhagoletis cingulata.* It causes little or no trouble in Ohio, but is a more serious pest in New York.

In September a small, dark red beetle, less than one-fourth inch long, may be found feeding on the leaves of cherry. The antennae and parts of the legs are black. It is partial to the wild cherries, and also feeds on peach and plum. This is the **Cherry Leaf Beetle,** *Galerucella cavicollis.* It may be destroyed in the fall by spraying with arsenate of lead, 3 to 5 pounds in 50 gallons of water.

The common **Dogday Cicada** or **Dogday Harvest Fly,** *Cicada linnei,* deposits its eggs in the twigs of cherry and other trees. The musical notes or drumming of the male cicada during the middle of the day is a familiar sound during August and September. Injury by this insect is generally slight and it is scarcely necessary to trim out and burn the twigs containing eggs.

A **Flat-Headed Borer**, *Dicerca divaricata*, larger than the flat-headed borer of the apple, otherwise closely resembling it, commences to work in the sapwood of the cherry in summer or fall, the work of the latest hatching specimens becoming noticeable in September. The remedies recommended for the apple tree borers should be used. See page 99.

Until late in September, full-grown caterpillars of the **Promethea Emperor Moth**, *Callosamia promethea*, may be found feeding on the leaves of cherry, especially of the wild species. This is a large, bluish white. or bluish green caterpillar, about 2½ inches long, with 4 yellow or red tubercles or horns on the thoracic segments, i. e., on the two posterior rings bearing feet; there is also a large horn of similar color on the back of the 12th segment, counting from the head. Each of the segments is also ornamented by deep blue warts or buttons, 8 being the usual number to a segment, except they are fewer in case of those decorated with the larger horns. When full fed, the caterpillar draws the opposite edges of a good sized leaf together, thus making a kind of cylinder, except that the ends are closed, and within this it spins a very tough, light-colored cocoon. The stem of the leaf, enclosing the cocoon, is attached by a strong band of silken threads to the twig which produced it. So strong is this connecting band that it cannot be broken except by a very strong pull. The cocoons may be clipped from the trees and burned after the leaves have fallen. No other remedy than hand-gathering is needed when the worms are feeding.

In early September, the full-grown caterpillars of the **Io Moth**, *Automeris io*, may be found feeding on cherry, corn, apple and a great variety of other plants and fruits. The caterpillar is at this time about 2½ inches long and ornamented on each side by a broad, brown stripe, margined with white and reddish lilac on each side, and has the body covered with clusters of black-tipped, green, branching spines, which are furnished with a sharp, nettling quality, irritating, and to some degree, poisonous to the skin. The general body color is pale green, the breathing pores yellow, ringed with brown. During September, the caterpillars descend to the ground and on the surface spin a rather slight but tough, brownish cocoon covered with bits of dead leaves and other rubbish, in which they remain until the following July. Hand-picking, using a pair of gloves to protect the skin, is the only remedy required.

Throughout the fall the caterpillars of *Limenitis ursula* occur in sparse numbers, feeding on cherry and other leaves. These larvae, as well as the cocoons, so closely resemble those of *L. archippus* that no further description is necessary. See page 119.

PEAR SLUG, *Eriocampoides limacina*. See page 116.

BUFFALO TREE HOPPERS, *Ceresa bubalis*, et al. See pages 95-96.

FALL WEBWORM, *Hyphantria textor*. See page 94.

WHITE-MARKED TUSSOCK MOTH, *Hemerocampa leucostigma*. See page 95.

SHOT HOLE BORER or FRUIT BARK BEETLE, *Scolytus rugulosus*. See page 123.

PEACH BARK BEETLE, *Phloeotribus liminaris*. See page 125.

BUD MOTH, *Tmetocera ocellana*. See page 103.

GRAY DAGGER MOTH, *Apatela interrupta*. See page 118.

OCTOBER

PEACH BORER, *Sanninoidea exitiosa*. See page 126.

LESSER PEACH BORER, *Sesia pictipes*. See page 126.

NOVEMBER

LEAF CRUMPLER, *Mineola indiginella*. See page 110.

BUD MOTH, *Tmetocera ocellana*. See page 103.

TREE CRICKETS, *Ecanthus spp*. See page 109.

BAGWORM or BASKET WORM, *Thyridopteryx ephemeraeformis*. See page 110.

FALL CANKER WORM, *Alsophila pometaria*. See page 107.

APPLE TREE TENT CATERPILLAR, *Malacosoma americana*. See page 109.

FOREST TENT CATERPILLAR, *Malacosoma disstria*. See page 109.

SAN JOSE SCALE, *Aspidiotus perniciosus*. See page 108. Troubles sour varieties very little.

EUROPEAN FRUIT SCALE, *Aspidiotus ostraeformis*. See page 121.

ECCENTRIC SCALE or PUTNAM'S SCALE, *Aspidiotus ancylus*. See page 108.

ENGLISH WALNUT SCALE or GOPHER SCALE, *Aspidiotus juglans-regiae*. See page 128.

EUROPEAN FRUIT LECANIUM, *Lecanium corni*. See page 121.

GLOBULAR SCALE, *Lecanium prunastri*. See page 121.

EUROPEAN PEACH SCALE, *Lecanium persicae*.

OYSTER SHELL SCALE, *Lepidosaphes ulmi*. See Winter Manual, page 12, and Spring Manual, page 51.

CHERRY SCALE, *Aspidiotus forbesi*. Resembles San Jose Scale, but is of lighter color and has orange-red exuviae; also the dot and ring are not very noticeable.

The CHERRY APHIS, *Myzus cerasi*, lays its shiny black eggs in the usual situations about the forks of the limbs. The usual winter sprays at dormant strength will probably destroy a fraction of these eggs. Liberal pruning and burning of the eggs may be useful at times.

CLOVER MITE, *Bryobia pratensis*. See page 80.

SCHEDULE OF FALL OPERATIONS FOR CHERRY INSECTS

1. In case of serious infestation of a cherry orchard with Curculio or the Cherry Fruit Fly, plowing in early September would be of some service for destruction of the pupae.

2. Spraying with arsenicals may be useful against the Pear Slug, and the various species of caterpillars and beetles which feed on the leaves.

3. Keeping the weeds and undergrowth in and around the orchard closely mown will tend to discourage Tree Crickets, Tree Hoppers, Leaf Hoppers, Grasshoppers, etc.

4. Whitewashing the trunks and large limbs in early September will assist to control the various bark beetles.

5. Hand-picking may be used against the larger caterpillars and for winter cocoons of the Bagworm.

6. Spraying with lime-sulfur solution after the leaves have fallen will be useful for San Jose and the armored scales, Budworm, Leaf Crumpler, Aphid eggs and those of the Clover Mite.

7. Spraying with kerosene emulsion or miscible oil at high strength, after the trees are dormant, will be the best treatment for the Soft Scales.

8. Banding with tanglefoot may be employed against the Fall Canker Worm if necessary.

9. Use the knife and bisulfid of carbon for large trunk borers.

10. Pruning may help to destroy the eggs of Cicadas, Tree Crickets, Tree Hoppers, Tent Caterpillars, etc.

QUINCE INSECTS

SEPTEMBER

BAGWORM or BASKET WORM, *Thyridopteryx ephemeraeformis*. See page 110.

LEAF CRUMPLER, *Mineola indiginella*. See page 110.

PEAR SAWFLY or PEAR TREE SLUG, *Eriocampoides limacina*. See page 116.

CODLING WORM, *Carpocapsa pomonella*. See page 91.

OCTOBER AND NOVEMBER

The Quince Curculio, *Conotrachelus crategi*, is a near relative of the Plum Curculio. It is somewhat larger than the latter insect, of an ash-gray color, with seven elevated ribs running longitudinally with the wing-covers, and a double row of dots between each pair of ribs. It occurs most commonly on wild haws, laying its eggs in June. It reaches full larval development in July or August, then descends a few inches into the earth and remains there until the following spring, when it becomes a chrysalis in May. Where

abundant on quince, late fall plowing or pasturing with hogs will assist to control it. Also the destruction of nearby wild haw trees will quickly reduce its injuries to quince orchards.

ROUND HEADED APPLE TREE BORER, *Saperda candida.* See page 99.

SAN JOSE SCALE, *Aspidiotus perniciosus.* See page 108.

CLOVER MITE, *Bryobia pratensis.* See page 80.

INSECTS OF THE GRAPE

SEPTEMBER

During the summer the leaves of grapes, especially the Clinton variety, may become covered over on the under surface with hairy warts or little galls with the opening on the upper side of the leaf. Similar galls may be found on the fibrous roots. If the interior of these galls be examined early in their growth, they will be found inhabited by a small aphis or plant louse, known as the **Grape Phylloxera,** *Phylloxera vastatrix.* European varieties of the grape are greatly damaged by it and are, therefore, not grown east of the Rocky Mountains. American roots are more immune from attack, but differ considerably in resisting power. The more common American varieties belong to the species, *Vitis labrusca*, which ranks next to the Old World grape, *Vitis vinifera*, in susceptibility to injury. Such grapes, rooted from layers or cuttings, may suffer to a considerable extent. Roots of the following species are recommended for use in grafting, the preference being in the order given: *Vitis rotundifolia*, *V. riparia*, *V. rupestris*, *V. cordifolia.* Plucking and burning the galled leaves, soon after the galls appear, to destroy the insects contained therein may be of some little help. The grapes commonly produced in Ohio are but little damaged by this insect. So far, our vineyardists have not been compelled to give it attention. It may be present in considerable numbers one season and by the next will have almost wholly disappeared.

Throughout the whole of Autumn, the **Grape Leaf Hopper,** *Typhlocyba comes*, often erroneously designated as the "Grape Thrips," may be found on the undersides of the grape leaves, causing great injury to foliage, vines and fruit. These are sucking insects and cause injury by pumping sap from the leaves. The leaves take on a whitened, spotted and rusty appearance, and the insects may be frightened out in swarms by disturbing the leaves. These insects are scarcely one-eighth inch long, and the wings are barred and spotted over with yellow and red. There are several color varieties, but all belong to the same species. Nearly all are adults by September and quite hard to kill. By spraying with

kerosene emulsion diluted with 15 to 20 parts of water, or with whale oil soap, 1 lb. in 10 gallons of water, it is possible to knock many to the ground where they will remain a short time trying to clean themselves. While on the ground, spray with kerosene emulsion diluted with 6 or 8 parts of water. This may be applied with a second pump following the first, or a gauged Kerowater pump may be used, setting it first to throw a five percent mixture which will not injure the foliage, if working correctly, and then reset it to throw a 15 or 20 percent mixture to kill the insects knocked to the ground.

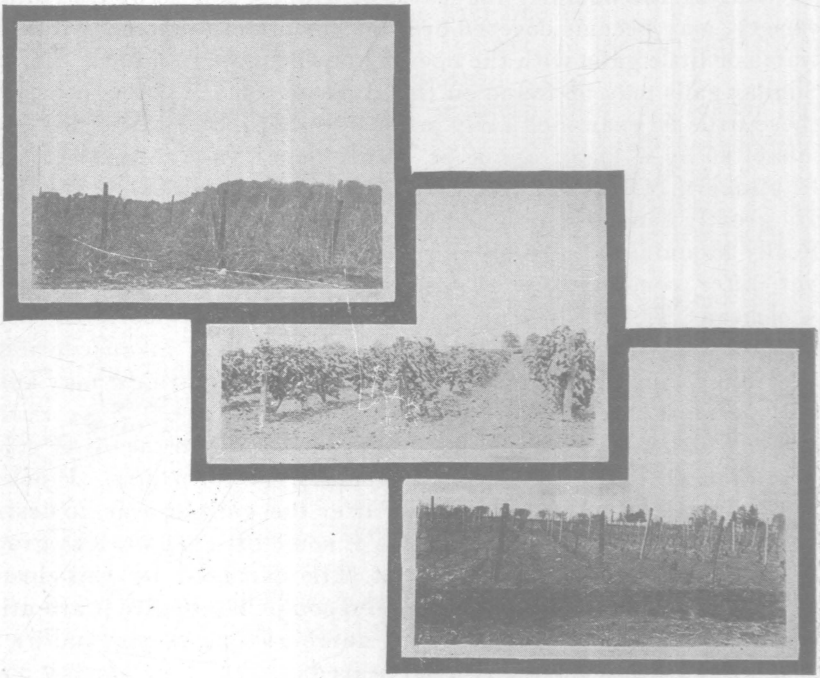


Plate XI. Three Types of Vineyard Care.

One neglected and over-run with weeds; a veritable nursery for the Grapeberry Worm and other grape pests.

One cultivated and sprayed, but not sufficiently pruned to permit entirely effectual spraying.

One cultivated and pruned; in fine condition to receive proper and effective treatment for Grapeberry Worm and other pests when summer opens.

On a small scale, it is possible to catch the adults with a tanglefoot shield. A light frame of wood about eight feet long and four feet high is constructed and, to the crosspiece at the bottom, which should be elevated about one foot from the ground, are fastened several stiff wires bent to the shape of a hayrake tooth. These are so fastened that the teeth bend inward and downward to the ground

at the base of the plants, when the shield is placed in position, and the insects are frightened toward it by beating or jarring the vines from the opposite side. The framework, including the wires, are covered over with oilcloth and this is then painted with tanglefoot. A good tanglefoot preparation for this purpose is made by boiling together one quart of melted resin and one pint of castor oil. The leaf-hoppers hibernate as adults beneath grass and leaves and under cover crops in and near the vineyard. Burning around borders and along the rows and plowing the middles in late fall or early winter will destroy great numbers of them. Rigid clean culture will nearly control them. If proper spraying with nicotine solution, kerosene emulsion, or whale oil soap is done in early summer, while the insects are yet nymphs, these fall measures will hardly be needed.

Among insects, injurious to the fruit of the grape, the Grape-berry Moth, *Polychrosis viteana*, easily ranks as the worst in Ohio. By September, many of the yet green grapes have been entered by the caterpillars, a purplish or reddish spot being located around the entrance opening. When full grown, the caterpillar is about three-eighths of an inch long, slender, greenish to purplish in color, depending on the stage of maturity reached by the fruit pulp devoured, the head greenish above and brownish in front, the thoracic feet blackish. When the eggs of the third brood, which are laid on the skins of the grapes, hatch in early September, the young larvae burrow through the skin into the pulp, usually at or near the spot where they issued from the egg. This opening furnishes a means of ingress for the spores of rots and fungous diseases, and at a later time, these wormy grapes crack open and decay. The caterpillars migrate to other grapes as soon as their first food supply becomes too much decayed to be healthful for them. A single caterpillar may enter and destroy three or four different grapes, and when the insects are very numerous, they may ruin the contents of every grape in a large bunch, the empty skins of the grapes adhering to each other, but weighing no more than if they were so many paper shells. Entire crops are sometimes rendered unfit to harvest for any purpose whatsoever.

When full grown, the caterpillars cut small rounded flaps in the leaves which are folded back and fastened to the uncut side, thus forming a little pocket or tube within which they pupate. Those leaving the fruit in late fall, after the leaves have partially fallen, hibernate over winter under similar flaps made on the fallen and decaying leaves found on the ground.

During the fall, it may pay to pick the wormy berries and destroy them as fast as they are found, but this will be unnecessary

if spraying was properly done during the Summer. It certainly will be of help to collect the fallen leaves and burn about the last week in October, and to burn over at the same time all grasy and weedy patches and fencerows surrounding the vineyard. The cocoons fall away from the decaying leaves in early winter and therefore fire must be used early, if at all. Careful plowing, by which all surface leaves and debris is covered, will be more effectual than burning.

Another larva quite resembling the Grapeberry Worm in its feeding habits is that of the Grape Curculio, *Craponius inaequalis*. The beetles cut small cavities into the berries and deposit their eggs therein. The larvae feed on the pulp and seeds and there is also, as a rule, a purplish ring around the puncture, the entire damage suggesting the work of the Grapeberry Worm. However, the latter has well developed legs and the body is of a greenish color and it is very active in its movements, whereas the curculio larva is whitish, legless and comparatively sluggish of movement. Egg-laying may extend into September and occasionally beetles of the new or hibernating generation lay eggs in late fall, but the larvae from these hardly ever reach maturity. The early beetles of the hibernating generation appear in summer, and the later ones continue appearing until late fall. A few remain in the ground in the pupa stage over winter. This adult is a small, black or brown snout beetle about one-tenth of an inch long. Throughout the fall, these beetles feed on the grape leaves, sometimes giving them a browned, scorched appearance. The feeding mark on the leaf is a minute line, one-sixth of an inch long and about one-fourth as wide as long. It appears as a short, whitish hair-line at first, but numbers of them on a leaf will cause the surface to become brownish after it has weathered for a time. Since the beetles feed upon the leaves to a certain extent, even after the fruit harvest, something may possibly be accomplished by spraying at that time with arsenate of lead. It might be unwise to spray with arsenicals before the berries are gathered. Collecting and destroying all infested berries at intervals of two weeks apart throughout the summer and fall may sometimes be a profitable measure. The beetles may also be captured during the early morning hours in the same way as the Plum Curculio, by jarring them onto sheets or into specially constructed curculio catchers. The beetles sometimes rest over winter under stones, lumps of earth or beneath the surface of the soil. However, more of them hide under trash bordering the vineyard, and they are said to be very partial to the litter in nearby woodlands. Clean culture would, therefore, be of considerable value.

The larvae of the **Grape Root Worm**, *Fidia viticida*, feed upon the roots of the grapes during the fall, causing a stunted, sickly growth of vine and fruit. In early September, the feeding marks of the adults on the leaves are still fresh and furnish a convenient means of diagnosis. These marks are at first whitish, narrow, chain-like marks, later becoming brownish, and a little later a hole through the leaf preserves the general form of the feeding mark. The larvae, which may be found on the roots, are less than one-half inch long, when full grown, and have a yellowish head and cervical shield, with the mouth parts darker. Most of the grubs collect beneath the point where the large roots leave the trunk. Where only a few vines are affected, it would seem possible to destroy the grubs by partially removing the earth and saturating the soil with a strong nicotine solution, or with a carbolic or coal-tar sheep dip, properly diluted, or carbon bisulfid can be used; but in case of a large vineyard the only advisable measure to take in autumn is to throw the earth toward the vines on each side at the last cultivation, thus forming a ridge along the row. The next spring most of the larvae will work into the top of this ridge to pupate, where they can be thrown out of their cells by cultivation in June or July, while they are helpless, and at that time most of them will inevitably perish.

The **Grapevine Flea Beetle**, *Haltica chalybea*, feeds on grape foliage in the adult form in summer and early autumn, but goes into hibernation very early, generally in September. Since it hides away in grassy borders around the vineyard, under loose bark on the vines and on the supporting posts, and under dirt, boards and trash on the ground, clean culture and a judicious use of fire in the grassy borders are measures worthy of adoption.

The **Grape Cane Gall Maker**, *Ampeloglypter seostris*, is responsible for the gall-like enlargements or swellings so often noticed on grape canes. These swellings are generally located just above or below a joint. Within the gall may be found a white, cylindrical, footless larva, which the following summer transforms into a small snout beetle. Grape-growers generally ignore their presence, since they are not specially injurious. The adult beetles leave the canes in August or September and hibernate over winter under leaves, grass and trash, in and around the vineyards. Clean culture will be of some use against them, especially burning over the borders in late fall.

During the month of September a large green "horn worm," *Ampelophagus myron*, the **Grape Vine Sphinx**, may be found feeding on grape foliage. When young, in early September, it may not be more than one-fourth inch long, and is of a pale-yellowish-green

color, with a conspicuously large head and a long black horn protruding upward from the hinder extremity. When full grown in late September, it is about two inches long, with a comparatively small pale-green head, spotted with yellow and a pale stripe running along each side. The body is green and spotted over with yellow. Seven oblique yellow stripes, directed upward and backward, are arranged along each side of the body. A white stripe, margined with dark green, extends along each side from just behind the head to the posterior end of the body. Along the back is a series of seven reddish spots, each surrounded with yellow. The horn varies from reddish to bluish-green, speckled with black in front, and sometimes with yellow behind. The feet are red, the fleshy legs pale green. Wide variations in color occur, the prevailing body color sometimes being pink, and again reddish, or brown.

Sometime in September the full grown caterpillar descends to the ground and draws a few leaves loosely together, binding them with silk, and within the cocoon, thus constructed, it spends the winter.

Handpicking is generally sufficient to keep them in check. The regular sprayings made with arsenicals for other insects serve to limit this one by destroying the first brood of worms, and probably enough poison still adheres to the foliage in fall to poison some of the caterpillars. The cocoons can be collected during the fall and burned, though this will very rarely, if ever, be necessary.

The Pandorus sphinx, *Pholus pandorus*, also feeds on grape foliage during September and October. When newly hatched, it is green with pinkish sides, and a long pink horn. With growth, the horn shortens and becomes curved and the body color changes to a reddish brown. The horn is replaced in the later stages by a dark, raised, glassy, eye-like spot. There are five oval, cream-colored spots along each side, from the 7th to the 11th segments inclusive. There is a conspicuous breathing pore in each of these spots; also some on the other segments, all black. This caterpillar buries itself in the ground to pupate. Handpicking is the only remedy needed.

Much resembling the preceding caterpillar is the Achemon Sphinx, *Pholus achemon*, which matures in September or earlier, and like the pandorus larva feeds on both grape and the Virginia Creeper. The mature larva is about three inches long, when at rest, and longer when crawling It varies in color from pale-straw yellow to reddish-brown, with darker sides, and is deep brown beneath. The horn which is present, when young, is later replaced by a polished tubercle with a central black dot. A broken line of brown extends down the middle of the back and a continuous one along

each side. Below the latter are six cream-colored spots from the 6th to the 11th segments, inclusive, with the spiracle or breathing pore of each of these segments located in the bottom of the cream-colored area. The head and next two segments are small, as is the case with *P. pandorus*, the third segment being swollen and very fleshy. It goes several inches beneath the ground to transform and there makes a smooth cell in which it changes to a polished, mahogany-brown chrysalis, with a short, blunt spine at the tail end.

Remedies are the same as for the preceding species.

The **Purslane Sphinx**, *Deilephila lineata*, is another "horn worm" occasionally found on grape in the fall. The moths of the second brood appear in September. They hover around flowers in the dusk of the evening like humming birds and by means of their long bills they suck the nectar from such long-throated flowers as honeysuckle blossoms. The moth is a trim stout-bodied insect, wearing a close fitting, rich-colored, tailor-like suit, and having a wing-expanse of 3 to 3½ or more inches. The fore wings have a rich, greenish, olive ground-color, with a pale-buff stripe extending through the middle from the base to the point or tip. Along the outer margin is a stripe of dull gray, and pure white lines mark the location of the veins. The hind wings are much smaller and crossed by a wide rosy band with a black border on each side of it; back of the hindmost black band is a white strip, forming the hind border of the wing. Extending from the middle of the head back to the hindmost point of the thorax on each side, extends a curved white line with the concave side outward, forming an inverted V, and from the extremity of each leg of the V, a white line follows the border of the thorax on each side, continuing above each eye over the head. Between each of these border lines and the middle ones is another white line, making six on the thorax. The abdomen is greenish-olive, spotted with white and black. The eggs for the second brood are laid in early September and the larvae feed on purslane, grape, apple and the foliage of a number of other plants. The caterpillar is very variable in color, commonly being yellowish-green with the breathing pores on each side circled with black, and the black edged with yellow. Higher up is a lateral connected chain of spots extending from the head to the posterior horn, each spot being formed of two black crescents with the points of each contiguous pair directed toward each other, enclosing a patch of crimson, with yellow bordering the crimson below. Another form of the caterpillar is black with a yellow line down the back and two rows of yellow spots and dots along the sides. Late in the fall, the caterpillars go a few inches below ground and, inside of smooth cells,

transform to chrysalids in which state they remain until the next year. Handpicking is the only remedy needed.

The Dark Veined Deilephila, *D. gallii*, much resembles the preceding, and has practically the same life history and habits. The insect is a little smaller than *D. lineata*, the moth having considerably less than three inches of wing-expanse, and it also has a shorter body. The body above is olive-green and there are white stripes along the borders of the thorax, but not on the back. The veins of the fore-wings are not white, as they are on the wings of *D. lineata*. The larva is 2½ inches long, deep olive-green or blackish in color, with a pale-yellow or whitish line along the middle of the back, extending as far as the horn, and on each segment from the 3rd to the 12th, inclusive, is a pale yellow spot on each side. The sides of the body below are sprinkled over with small yellowish tubercles. The reddish horn is curved backward and tipped with black. The breathing pores are yellow, surrounded with a black margin. Besides grape, it also feeds on *Epilobium* or willowherb. Not common.

The second brood of larvae of the Eight-spotted Forester, *Alypia octomaculata*, appears in September. This caterpillar is white or pale-bluish, with eight black lines and an orange band on each segment. There is also a line of white spots along each side just above the lower surface. The head and the upper part of the first segment behind the head are orange, spotted with black. When disturbed, the caterpillar swings from the leaf on which it is resting by means of a silken thread, and later climbs back to its place by the same means. It makes a cell a little below or upon the surface of the ground and in this changes to a chrysalis in which state it remains until the next June. Handpicking will be useful against the fall brood, or spray with a decoction of hellebore. Use arsenicals on vines not carrying fruit.

The second brood of larvae of the Grape-vine Leaf Roller, *Desmia funeralis*, comes in September. The moth is black, the abdomen being crossed with two white bands in case of the female, and with one in the male. The wing expanse is about an inch, the wings being blackish, with a coppery reflection, and trimmed with white. There are two oval white spots on each of the fore wings, and one of similar color on each of the hind wings of the male, generally two on that of the female. The antennae of the male are swollen and elbowed just above the middle, those of the female are slender and of uniform thickness. The eggs are laid singly and the young caterpillar makes for itself a tube by rolling over the edge of a leaf and fastening it with silk, going out to feed as occasion requires. New and larger folds are made as the caterpillar grows.

When full grown, it is about ¾ inch long, dark yellowish-green in color, bearing sparse, fine, yellow hairs. The head is yellow or reddish-yellow, and a crescent-shaped patch of similar color ornaments the segment just behind the head. There are two or three black spots on each side and one on the segment next the terminal one behind. When disturbed, the caterpillar wriggles out and hangs by a thread. The chrysalis is formed inside the folded leaf. A quick, firm squeeze of the folded leaf in the hand will destroy the caterpillars. Later in the season the folded leaves containing the chrysalids may be picked and burned. Spraying in the earlier part of the season diminishes the fall brood, not only because of reducing the first brood and thus limiting the later multiplication, but there is probably still enough poison adhering to the leaves, even in fall, to destroy many of the worms.

A slender, looping worm, *Eustroma diversilineata*, may be found eating holes in grape leaves during the fall months and hibernating over winter in the larval form in some snug retreat. They are very variable in color, being sometimes yellowish green, whitish green, deep red, and again dark brown to nearly black. When alarmed they straighten out and remain motionless, closely mimicking twigs, colored like themselves. Spray, if necessary, with hellebore, or with arsenicals if vines are not in fruit. Usually of but little importance.

The **Yellow Wooly Bear**, *Diacrisia virginica*, is a well known inhabitant of gardens and the vineyard. It is about two inches long, when full grown, very hairy, usually yellowish, sometimes white, again straw-colored, or it may be reddish or light to dark brown. A few black hairs are often interspersed among the others. It constructs its cocoon, composed largely of its woolly coat, cemented with silk, under any loose shelter that is conveniently near. The moth is milky white with black spots on the wings. A common arrangement is two spots on each fore-wing, and three on each of the hinder ones. These spots are sometimes wanting. The abdomen is orange yellow, fading into white, with a row of black dots along the middle of the back and another row along each side. The thighs of the fore legs are yellow. Hand picking is the only remedy needed, and this is generally unnecessary.

A large **Green "Stink Bug"**, *Nezara pennsylvanica*, sometimes punctures the ripening grapes, sucking the juices, and leaving a nauseous flavor to the berry. The tender parts of the vine may likewise be laid under tribute. This insect is a little over one-half inch long, flattened, and with a curved, triangular outline. It is grass-green in color, margined with a light yellow line, marked at each joint of the abdomen with a black spot. The antennae are

5-jointed, blackish, shaded with yellow on the first and last joints. Hand-picking and throwing the insects into kerosene and water is the only practicable remedy.

Another large, green bug, *Pentatoma ligata*, the **Bound Tree Bug**, has similar habits and much resembles the preceding. It is edged all around with red, except on the head, and has a pale red spot on the middle of its back. The antennae are green, except the last three joints, which are black.

Various species of **Katydids** and **Grasshoppers** (see page 58) frequent vineyards in the fall, but are not very mischievous. The flattened, elliptical, smooth, slate-colored eggs of the Katydids are laid in one or two rows, overlapping each other like the shingles on a roof, and are fastened to a roughened line on the cane with a gummy preparation. These insects are not very injurious, being very general feeders. Such eggs as are casually noticed may be trimmed out and burned, but it is hardly worth while to take the time to make any special hunt for them.

Sometimes in August and September the berries of certain varieties of grape commence to shrivel and dry up. An examination of the interior of the berry shows a few seeds enlarged and the normal number wanting. The seeds of apparently normal berries may likewise be infested. The enlarged seeds may contain a small, white, footless grub which will develop the following summer into a small, black, four-winged, wasp-like fly. This insect is known as the **Grape Seed Chalcis**, *Evoxystoma vitis*. It seems not to be partial to some of our cultivated varieties, but is recorded on the Clinton, Delaware, Isabella and Rogers No. 4. It seems to prefer the native wild grapes. In case of its ever becoming of importance, the infested berries should be picked and destroyed and no unharvested fruit should be left in the vineyard; also the destruction of nearby wild grapes would be important under such conditions.

OCTOBER

Many of the insects scheduled for September are continued into October and reference should be made to the preceding section when attempting to identify injurious insects noticed during this month.

NOVEMBER

The **Red Shouldered Sinoxylon**, *Sinoxylon basilare*, injures the stems of grapes by boring into them, also into the trunks and branches of peach and apple trees. The beetle is about one-fifth inch long, black in color, with a large red patch at the base of each wing-cover. The wing covers are obliquely shortened inwards from

behind, forming an inverted V, each side of which bears three teeth. Infested grape wood should be burned, and when it is at work on other trees, the same treatment should be given as for other bark beetles.

The Cottony Maple Scale, *Pulvinaria vitis*, is often present on grape, and after the leaves have dropped may be discovered as a flattened, oval or somewhat hemispherical, buff or brownish, unarmored scale, adhering closely to the bark. Earlier in the fall the insects are located on the leaves and are of a pale green color with a brownish stripe down the back. The males, minute two-winged flies, impregnate the females in August and September and then die. The females move to the twigs in October and become dormant. They may be sprayed when the vines are dormant with kerosene emulsion diluted with 6 to 8 parts of water. If not too numerous, pruning and the use of a wire brush to effect their removal will be useful.

Along the stems of the grape can sometimes be found a small, roundish, flat, tan-colored scale, with a bright yellow nib located near its center, the scales being generally arranged in well defined longitudinal rows. This is the Grape Scale, *Aspidiotus uvae*. It may be destroyed by spraying after the leaves have fallen with lime-sulfur solution or with a soluble oil.

SUMMARY OF FALL REMEDIES WHICH MAY AT TIMES PROVE USEFUL FOR GRAPE

1. The adult Grape Leaf-hopper may be captured on a small scale by frightening them, by jarring, to fly against tanglefoot paper fastened to a suitable frame and set up on the side of the vines opposite the operator.

2. Periodically picking diseased berries and destroying them by deep burial or in some other way will sometimes pay against the Grapeberry Worm, the Grape Curculio and the Grape Seed Chalcis.

3. Hand-picking or pinching should be resorted to for the control of the Grape Leaf Roller, the Grape Vine Sphinx, Pandorus Sphinx, Achemon Sphinx, Purslane Sphinx, Eight-spotted Forester, Yellow Woolly Bear and the Stink Bugs.

4. Gathering and burning all kinds of trash, especially the fallen grape leaves, from in and around the vineyard, burning over adjacent grassy borders and woodlands, and practicing clean culture generally will reduce the numbers of Grape Curculio, Leaf-hoppers, Grapeberry Moth, Grapevine Flea Beetle, Woolly Bears, the Grape Leaf Roller and the Grape Cane Gall Maker.

5. Ridging the dirt along the rows by throwing the dirt toward the vines from each side, at the last cultivation, will make a trap for

the **Grape Root Worm** the following summer. The larvae will work their way into the top of the ridge to pupate, in which stage they may be destroyed by cultivation during the next June and July.

6. **Destruction of nearby wild grapes** will assist in controlling the **Grape Seed Chalcis**, the **Berry Moth** and various other grape pests.

7. **Spraying with strong kerosene emulsion during the dormant season** will help to control **Cottony Maple Scale. Spraying with lime-sulfur or soluble oil** will assist to control the **Grape Scale.**

CURRANT INSECTS

SEPTEMBER

FALL WEB WORM, *Hyphantria textor.* See page 94.

YELLOW WOOLLY BEAR, *Diacrisia virginia.* See page 141.

Sometimes **Mites** or **Red Spiders** attack the leaves of currants during dry weather and cause them to become speckled over with whitish and finally to wither and die. They are usually on the underside of the leaves, sheltered beneath a fine web. Small, smooth, spherical, translucent eggs, colorless or yellowish, are scattered beneath the web. Spraying with self-boiled lime-sulfur solution is a good remedy if applied soon enough.

After the leaves have fallen so the canes of currant are well exposed, many among them are sometimes observed to have been pruned off across the top, and by splitting the cane, a tunnel is found running down the pith chamber for from four to six inches. The excrement or frass of the borers is scattered along the tunnel and after early September the lower part of the tunnel will be found to have been cleaned out and is occupied by the grub, enveloped in a thin, silken cocoon. A passage way from the hibernating cell to the bark is eaten out and by means of this opening the adult sawfly, into which the grub transforms, makes its way to the outside the following May. The sawfly is a close relative of the insect which lays eggs to produce the well known Currant Worm. It has four wings, a shining black body, and light brownish legs. The abdomen of the male is brownish-yellow, while in the female the first half of the abdomen is of a reddish-orange color and the rest is black. This insect is known as the **Currant Stem Girdler,** *Janus integer.* By cutting off and burning about 8 inches of the tips from the girdled canes, any time during the occupancy of the tunnel by the larva, the insect will be controlled.

NOVEMBER

IMPORTED CURRANT BORER, *Sesia (Aegeria) tipuliformis.* See Winter Manual, page 24.

NATIVE CURRANT BORER, *Psenocerus supernotatus.* See Winter Manual, page 25.

SCURFY SCALE, *Chionaspis furfurus.* Spray with lime-sulfur after leaves fall.

OYSTER SHELL SCALE, *Lepidosaphes ulmi.* Spray with lime-sulfur after leaves fall.

SAN JOSE SCALE, *Aspidiotus perniciosus.* Spray with lime-sulfur after leaves fall.

EUROPEAN FRUIT SCALE, *Aspidiotus ostraeformis.* Spray with lime-sulfur after leaves fall.

GOOSEBERRY INSECTS

SEPTEMBER

The **Mealy Flata or Frosted Lightning Hopper,** *Ormenis pruinosa*, is sometimes found on gooseberry as well as grape, sassafras, corn and other plants. It is a lead-colored or pale green, wedge-shaped insect, frosted over with a whitish bloom, and has its wings lying flat against its sides and prolonged behind the body to meet each other. It is a sucking insect. No remedy is needed. The eggs are laid in twigs of sassafras and other trees in a continuous raised slit, sometime in September or soon thereafter.

NOVEMBER

If the **Gooseberry Fruit Worm,** *Zophodia grossulariae*, was abundant in the fruit, carefully rake together all leaves and trash as soon as they are dry enough to burn. The chrysalis stage is spent in a brown, paper-like cocoon among such rubbish.

For **San Jose Scale,** *Aspidiotus perniciosus*, spray with lime-sulfur after the leaves have fallen.

INSECTS OF THE RASPBERRY AND BLACKBERRY

SEPTEMBER

FALL WEBWORM, *Hyphantria textor.* See page 94.

UNICORN PROMINENT, *Schizura unicornis.* See page 93.

RED-HUMPED CATERPILLAR, *Schizura concinna.* See page 94.

BUD MOTH, *Tmetocera ocellana.* See pages 99-100.

YELLOW WOOLLY BEAR, *Diacrisia virginica.* See page 141.

OCTOBER AND NOVEMBER

The **Blackberry Crown Borer,** *Bembecia marginata*, appears in the adult form during late August and in September. It is a clear

winged moth with a wing expanse of about one inch, or a little less. The front wings are transparent and heavily margined with reddish brown, the hind wings are similar but margined with darker brown. The body is black, banded transversely with bright yellow. The eggs are laid upon the canes and the young larva, upon hatching, burrows inside and feeds upon the pith near the foot of the cane. The larva is provided with feet and spends the winter inside the cane or root, below the level of the ground. The larva can often be located by the small aperture of entrance, 4 to 6 inches high on the cane, and such canes, with their roots, may be dug out and burned in late fall. It attacks both blackberry and raspberry.

An insect with habits very similar to the preceding is the **Cane Borer** of the Blackberry and Raspberry, *Oberea bimaculata*. Canes which show evidence of having been girdled above, so that a section of the cane has died and withered, and, perhaps, died off, may contain the larva which feeds in the pith. This is a footless grub with a small, dark brown head, being about an inch long by early September. If the presence of the insect is detected during the fall by the pruned canes, these canes should be cut close to the ground and burned.

The **Gouty-gall beetle**, *Agrilus ruficollis*, is in the larval stage in the fall, the young borers commencing work in July and August. The slender, round-headed larvae enter the canes at the bases of the leaf-stalks, and from such points work around the canes in long, spiral tunnels through the sapwood. Later in the season, the canes swell over the eaten areas, forming enlargements or galls which are very conspicuous when the leaves fall. The only remedy is to prune out and burn the galls containing the larvae, and since galled canes will never prove of value, they may be cut out whenever discovered. Cut wild canes along roadsides and in nearby woodlands and burn in the fall of the year after the larvae have entered them.

One of the most common forms of injury to the canes of blackberry and raspberry is a series of punctures resembling a line of pin pricks, ranged longitudinally with the cane. By splitting the cane there will be found in each puncture an elongated, yellowish, slightly curved egg, about one-eighth of an inch long. The insects which lay these eggs are pale, whitish-green insects, with long, thread-like antennae, and whitish or membranous wings, which, particularly in case of the males, lie flat on the back. With some species, there are dusky stripes on the head and thorax, and the legs and antennae are blackish. They are allied to the grasshoppers and crickets and are commonly known as **Tree Crickets**. There are two common species, *Ecanthus nigricornis* and *Ecanthus quadripunctatus*, which oviposit

in raspberry and blackberry canes, chiefly during the month of September. The young crickets, when first hatched in midsummer, feed to a limited extent upon plant lice, but in the fall upon ripe fruits or other succulent food. There is no remedy except to prune out and burn the canes containing eggs. This may be done in late fall or early spring.

A large gall, two or three inches long, sometimes found on blackberry canes, is divided by four or five furrows into as many longitudinal lobes. Within the gall can be found small, footless, whitish grubs, which, in the spring of the year, transform to small, four-winged flies. The insect is not very important, but the galls should be pruned out and burned. This formation is known as the Pithy Gall of the Blackberry, and the insect causing it is *Diastrophus nebulosus*.

A closely related gall of the blackberry is known as the Seed-like Gall, and is caused by *Diastrophus cuscutaeformis*, much resembling the preceding species. This is a composite gall, consisting of a ring of single seed-like galls, the belt being an inch or an inch and one-half in depth. Cut out and burn.

The Rose Scale, *Aulacaspis rosae*, a snow-white, armored scale, with a yellowish nib, is often abundant in raspberries and blackberries. The male is flattened and elliptical in shape, with three slightly elevated longitudinal ridges. Prune out and burn the worst infested canes after the leaves drop, then spray with lime-sulfur solution.

SUMMARY OF FALL OPERATIONS IN THE RASPBERRY AND BLACKBERRY GARDEN

1. Pruning out and burning the affected canes will be of use against the Blackberry Crown Borer, the Raspberry Cane Borer, the Gouty Gall Beetle, the Tree Crickets, and the Pithy Gall and the Seed-like Gall of the Blackberry.

2. Spraying with lime-sulfur solution after the leaves have fallen will be of service against the San Jose, Scurfy and Oyster Shell Scales and the Bud Moth.

3. Hand-picking or spraying with arsenicals can be employed if ever necessary, against the Fall Webworm, the Unicorn Prominent, the Red Humped Caterpillar and the Woolly Bears.

4. Raking together and burning the fallen leaves will be useful against the Apple Leaf Miner.

STRAWBERRY INSECTS

SEPTEMBER

For detailed information regarding White Grubs or the larvae of May Beetles (*Lachnosterna spp.*), see page 59. Sod or grass land is

likely to be full of grubs and if spring planting on such land is contemplated, it should be plowed during the preceding fall and a herd of hogs turned on it, to exterminate the grubs before winter.

Besides the various grubs of *Lachnosterna*, those of the **Goldsmith Beetle**, *Cotalpa lanigera*, live in the earth and feed upon the roots of strawberry as well as upon those of other plants.

White Fly, *Aleyrodes vaporariorum*.See page 160. Mowing and burning as for the Leaf Rollers will be effective against the White Fly.

The second or fall brood of larvae of the **Strawberry Leaf Roller**, *Phoxopteris fragariae*, are to be found feeding on the foliage in September, reaching maturity near the end of the month. They roll the leaves into cylindrical cases, fastening them with threads of silk. These caterpillars are about one-third to one-half inch long, and generally of a yellowish-green color, though brown or brownish are terms that may be correctly applied to many specimens. The head is yellowish, with a dark, eye-like spot on each side. There is a yellowish, horny shield on the segment just behind the head. In late September it changes to a chrysalis in the fold of the leaf, and remains here over winter. Spraying with arsenate of lead may be resorted to while the caterpillars are feeding, but it is not very effective while the worms are sheltered in the leaf folds. Burning over the beds during late September will destroy the chrysalids. Old beds, occupying the same ground for a succession of years, are most apt to need attention. First cut over the bed with a mowing machine, and allow the vines to dry in the sun for a day or two, then cover with additional straw, if necessary, and rake all mulching over the rows and set on fire, taking care to burn up everything along the row. If a gentle wind is blowing along the direction of the row, the work is more likely to be satisfactory. No bad results will follow the burning, except that a drouth coming immediately aftewards may prevent the development of a fruit crop the next year. In Kentucky there are sometimes three broods, and the same may occasionally be the case in Southern Ohio, the third brood of larvae spending the winter under the mulch along the rows and feeding on the foliage on pleasant days in early winter.

Another leaf roller, with very similar habits, is the **Obsolete-Banded Strawberry Leaf Roller**, *Archips obsoletana*. The third brood of larvae feed during September on strawberry leaves, protected in the same manner as the preceding species. A heavy spraying with arsenate of lead in early September would doubtless do much to exterminate the third brood, or mowing and burning over the beds, when the caterpillars are at work, or while the insect is in the chrysalis stage, would be even more certainly effective.

Plowing under old beds, past their usefulness, would, of course, destroy the insects feeding in them.

STALK BORER, *Papaipema nitela*. See page 62.

OCTOBER AND NOVEMBER

The **Strawberry Crown Borer**, *Tyloderma fragariae*, is sometimes very injurious in old beds. This insect is a small, yellowish-brown curculio or snout beetle which appears in the adult form in late September and October. There are generally several imperfectly defined black spots on each side of the back. During early September the white, legless grubs, about one-fifth inch long when full grown, are found mining out the crowns of the plants. The beetles leave the crowns in late fall to hibernate in the earth. They have no functional wings, and are, therefore, unable to fly; hence they do not spread rapidly and are generally, almost invariably, transported to new beds with the plants taken from old and infested beds. For transplanting, get new plants from uninfested beds, if possible; if not, it will be safer to do all transplanting in the spring. Plow up old beds as soon as infestation becomes severe and plant to some other crop. This insect is not known to thrive upon any other plant than strawberry.

Another snout beetle, at times injurious to the roots and crowns of strawberries, and occasionally received at the Ohio Station, is *Otiorhynchus ovatus*. It is said to collect in large numbers on the sides of houses in fall and early spring. The fall congregating occurs just before it enters the ground, or crawls beneath logs, bits of board, or bark, to hibernate, and as soon as it emerges in spring, it climbs some wall to bask in the sun. Clean culture about the beds will assist in its control, and, when collected on walls of buildings, with a brush sweep the beetles into a pail containing water and kerosene. The beetle is a little less than one-fourth inch long and very dark brown or blackish in color, the wing covers being ribbed with elevated ridges and depressed lines, alternating, the furrows being dotted with deep pits or punctures. The thorax is also deeply punctured and has a projecting angle at each side. The body is oval or egg-shaped.

The parent beetle of the **Strawberry Root Borer**, *Typophorus canellus*, hibernates over winter under such shelters as such insects ordinarily use. Clean culture in the fall, thus encouraging the insects to go a long distance to find winter quarters, will be of some value. The larva is a small, white grub, about one-eighth inch long, which feeds on the roots. The adult is a shining, stout, brown or blackish beetle, about one-eighth inch long, with four darker spots on the back, two on each wing cover. The beetles appear in July and

feed on the foliage in late summer and fall. Several varieties of this species, such as *aterrimus* and *6-notatus*, both of which may eventually prove to be good and separate species, are recorded as having very similar habits, all at times being injurious to strawberry.

The larvae of the small, uniformly, brownish beetle, **Graphops nebulosus**, injures the roots of strawberry in the same manner as the species of Typophorus. It has a metallic, coppery luster, and is of about the same size as they are. The grubs of these various species are practically indistinguishable by any ordinary method of separation. The beetles appear in June and July and deposit eggs for the brood of larvae, which works in late summer and fall. These larvae remain in the ground over winter, to continue damage the following spring.

Another singular grub which may be found feeding on strawberry roots during fall, winter, and spring, is that of the **Grape Colaspis**, *Colaspis brunnea*. It has on the under side of each legless joint, a pair of fleshy appendages, resembling legs, each tipped with two or three stiff hairs. The beetles are about one-fifth inch long, of a pale yellow or straw color, the wing-covers being sculptured with alternating, elevated ridges, and depressed lines or rows of punctures, or dots, like fine pin pricks. They appear during July and August and feed during those months to a considerable extent on the foliage of the grape. Since there is good reason for thinking the larvae feed on the roots of other plants than strawberry, such as corn, it is not clear that fall plowing for their destruction would be of much avail. Spraying with arsenicals to kill the beetles when they are feeding on grape would appear to be more dependable.

One of the **Dagger Moth** caterpillars, *Apatela oblinta*, is rather common in strawberry beds. The full grown worms may be found in early September. The caterpillar is about 1¼ inches long, of a deep, velvety, black color, with a transverse row of tubercles girding each segment. A tuft of short, stiff hairs radiates from each tubercle, those from the topmost tubercles being red in color, while those from the lateral ones are yellowish or mixed with yellow. Two rows of bright yellow spots extend along the back, one on each side, and below these a crescent-shaped, bright yellow band ornaments each segment. The breathing pores are white. Early in September it draws together a few leaves or other light fragments, and by webbing them together with silk, constructs a coarse cocoon in which it passes the winter. The following June it issues as a gray moth, with a zigzag line of blackish, dagger-like points crossing each

fore-wing in a transverse direction near the outer border. The hind wings are white. This is not a serious pest and remedial measures seem unnecessary.

CUTWORMS. See p. 59.

The **Strawberry Root Louse**, *Aphis forbesi*, lays its shiny, ebony-black eggs upon the stems and along the ribs of the leaves in late fall, usually in October and November. Either mulch and burn over infested beds in late November, or mulch and leave the straw in place to facilitate firing in the following March. For transplanting, choose plants from uninfested beds or fumigate with hydrocyanic acid gas. See Spring Manual, pp. 75-76.

SUMMARY OF FALL MEASURES AGAINST STRAWBERRY INSECTS

1. **Mowing and burning over the beds in September will be useful to control the White Fly, the Strawberry Leaf Roller, the Obsolete Banded Leaf Roller, the Stalk Borer and hairy caterpillars.**

2. **Plowing up old beds early in the fall will destroy some white grubs, especially if later pastured with hogs, the White Fly, Strawberry Crown Borer, the Leaf Rollers and the Grape Colaspis.**

3. **Late fall plowing will operate against cutworms, white grubs,** the several small beetles which hibernate in the earth, and the **Strawberry Root Louse.**

4. **If fall transplanting is practiced, plants from new or clean beds only should be selected to avoid transporting the Crown Borer,** various other strawberry beetle larvae, **the Strawberry Root Louse.**

5. **Mowing or mulching and burning over the beds in late November will destroy the eggs of the Strawberry Root Louse.**

ACKNOWLEDGEMENTS

The sources from which information has been gathered for the compilation of this bulletin are too numerous to mention. A considerable part of the field of economic literature has been laid under tribute, nearly all recent publications relating to the species mentioned having been consulted and used so far as advisable. Our own observations and experience have guided us very largely in selection of matter, and in many paragraphs original experience and advice are given as better than any similar matter published elsewhere.

Most of the illustrations have been prepared by Messrs. Goodwin, Beeching and Houser. For the cuts shown in Plate III, I am indebted to Professor Edmund Secrest, of the Forestry Department.

Date for treatment	Crops subject to attack	Name of insect	Description of insect	Character of injury	Remedies to use
Oct., Nov.	All	Cutworms	See Spring Manual, page 78.	See Spring Man., p. 78	See p. 61; also Spring Manual, p. 78.
Oct., Nov.	All	Grasshoppers	See Spring Manual, page 78.	See Spring Man., p. 78	See p. 58; also Spring Man., p. 78 and Summer Manual.
Sept., Oct., Nov.	Most	White Grubs	See Spring Manual, page 78.	See Spring Man., p. 78	See p. 59; also Spring Manual, p. 78.
Sept., Oct., Nov.	Most	Wireworms	See Spring Manual, page 79.	See Spring Man.. p. 79	See p. 58; also Spring Manual, p. 79.
Whenever necessary.	Various, but especially greenhouse crops.	Millipedes or "thousand-legged worms;" also called "galley worms" and sometimes, incorrectly, "wireworms."	Usually dark brown or black above, smooth and glassy, with a great number of segments, and apparently 2 pairs of lighter colored feet to each segment. Variable in size. Some of the larger species are 2 or 3 inches long, when mature. Some species curl themselves into a spiral, when disturbed, and emit a strong odor.	Sometimes multiply prodigously in heavily manured beds in greenhouses and gardens, and attack cucumbers, lettuce, strawberries, cabbage, etc., feeding upon the roots or stems underground and sometimes higher up.	Mulch the infested beds heavily with a good quality of tobacco dust or drench them with tobacco decoction. This treatment quickly eradicates them without injuring the plants.
Sept., Oct., Nov.	Most	Aphids	See Spring Manual, page 79.	See Spring Man., p. 79	See Spring Manual, p. 79.
Sept., Oct., Nov.	Potatoes, beets, beans, peas, asters, etc.	Blister Beetles or Black Potato Bugs, "Old Fashioned Potato bugs."	Long, slender beetles, with flexible, but tough wing covers, generally from one-half to three-fourths of an inch long, head with an abrupt neck and beetles possessing the property of raising blisters when they come in contact with the human skin.	Devour the foliage of plants, being partial to those in the nightshade and leguminous families, and specially fond of the blossoms of China asters and a few other garden flowers.	Spray with arsenate of lead, 3 or 4 lbs. to 50 gallons of Bordeaux mixture, adding a pound or two of dissolved fish oil soap to give odor to the mixture. Where practicable, resort to hand-picking. A pail containing water with a film of kerosene on top may be held beneath infested vines and the beetles can be jarred into the pail. This operation should be commenced as soon as the beetles appear and continued daily as long as necessary. Some species, such as the striped one, can sometimes be driven with green brush brooms under windrows of straw, scattered along the leeward border of the garden or at intervals through it; when the beetles are all well under cover, the straw is burned. Spraying with the coal tar sheep dips as repellents has been of value in some cases. They would probably be most valuable when used instead of fish oil soap in the Bordeaux-arsenate of lead combination. Since the larvae of blister beetles feed largely upon grasshopper eggs, careful destruction of these in the fall, (See p. 68) by limiting the food supply, will prevent the development of an excessive number of blister beetles the following year. On a small scale, valuable flowers can be protected, to some extent, by dusting the blossoms with cayenne pepper. Whatever remedy is used, commence early, as soon as the beetles are noticed.

INSECTS OF THE VEGETABLE GARDEN—Continued.

Date for treatment	Crops subject to attack	Name of insect	Description of insect	Character of injury	Remedies to use
Sept., Oct., Nov.	Most	Flea Beetles	Small, hard-shelled, oval beetles with enlarged thighs which enable them to leap quickly and for surprising distances; sometimes called "garden fleas."	Devour the epidermis from either side of the leaves and part of the pulp, often eating them full of small holes, and thus create a highway for the admission of blight germs and the spores of fungous diseases.	Spray with arsenate of lead combined with Bordeaux mixture as soon as damage becomes perceptible. Two lbs. of fish oil soap, added to each 50 gals. of spray, will add to the effectiveness of the treatment. Spraying with a solution of spent carbide, the refuse product of acetylene gas plants, is said to be quite effective in repelling the beetles Keep down all growth of weeds, especially weeds of the night shade family, to which the insects are partial.
Sept., Oct., Nov.	Most	Leaf-Hoppers or Jassids.	Small, leaping and flying insects, generally greenish or sober colored, but occasionally striped with bright hues; of triangular outline, and with parchment-like wings, closed flat down on the back and sides when at rest.	Suck the juices from grasses and plants, causing them to become spotted over, more or less, with whitish, and to wilt in dry weather. Are often the agents for spreading blights and fungous diseases by inoculating healthy plants from diseased ones with germs or spores carried on their bills.	Spray with kerosene emulsion diluted with 10 parts of water while the insects are young and their wings are rudimentary. When they become grown, many can be captured by frightening them to fly toward tarred or tanglefoot covered shields of paper, tacked to frames which are set in a favorable position on the opposite side of the plants from the operator.
Sept., Oct., Nov.	Many	Thrips	See Spring Manual, p. 85.	Cause withering and whitening of the tissues they attack.	Thoroughly clean up weeds and grassy borders around onion fields and gardens, burning over fields and gardens, also adjacent weeds and grass so far as possible, so as to destroy hibernating places of thrips. Collect and burn all remnants of old crops.

INSECTS OF THE VEGETABLE GARDEN—Continued.

Date for treatment	Crops subject to attack	Name of insect	Description of insect	Character of injury	Remedies to use
Whenever needful.	Most	Plant Bugs, *Lygus pratensis*, *Halticus uhleri*, *Poecilocapsus lineatus*, etc.	Rather small, flattened insects, the front half of the wing covers opaque and chitinous, the posterior half membranous. They have sucking beaks, move about rapidly, and are found in pastures, weedy patches, gardens, etc. Many are beautifully colored when seen with a magnifying glass. Most of the species are less than one-fourth inch long. Many of the larvae or nymphs are reddish in color. One species, *H. uhleri*, is known as the Garden Flea Hopper. Its thighs are enlarged, enabling it to leap like a flea. It is blackish in color and one form has short wings causing it to more nearly resemble a flea.	Puncture leaves and suck the juices, causing curling and wilting. Also may be the means of carrying blight germs and inoculating healthy plants through their punctures. Punctures in fruit may cause deformities or decay.	About the same as for Leaf-hoppers (See p. 153) Spraying with kerosene emulsion is sometimes useful, so also is dusting with pyrethrum. Clean culture is always important, since they multiply prodigiously among weeds, and many species hibernate under weeds and grass. Late fall burning of remnants of garden crops and over weedy patches is advisable.
Sept., Oct.	Many	Mites, Red Spider, etc.	Minute spiders, reddish or yellowish as a rule, often partially sheltered under a fine web.	Causing wilting, curling and whitening of tissues, giving a characteristic spotted appearance.	Flowers of sulfur mixed with water at the rate of one ounce to the gallon and sprayed over the plants is valuable against some species; others require a boiled lime-sulfur mixture, about 5 lbs. of lime and 5 lbs. of sulfur to 100 gallons of water. One gallon of concentrated lime-sulfur solution in 100 gallons of water can be used for this purpose on most plants. Many of these mites can be washed off the plants by a strong stream of water from a hose, care being taken not to drench the roots of the plants too much.

INSECTS OF THE VEGETABLE GARDEN—Continued.

Date for treatment	Crops subject to attack	Name of insect	Description of insect	Character of injury	Remedies to use
Whenever necessary.	Practically all, directly or indirectly.	Ants	Too well known to need any description.	Making mounds and nests where plants are trying to root, thereby preventing the possibility of growth, besides feeding to some extent on vegetation, and in some cases colonizing and caring for injurious aphids on roots of weeds and also of valuable crops. Enter houses from nests, often located in the garden, and pillage in the pantry or wherever food supplies are kept.	With an iron rod or sharpened stick make holes varying in depth from 3 to 6 inches, or more, and into each of these pour two or three tablespoonfuls of bisulfid of carbon and cover over at once with a few shovelfuls of earth to confine the fumes. If one treatment does not suffice, repeat in a day or two. When the nests are very large, the chemical is sometimes poured into a cavity in the nest, and then exploded by means of a flame attached to the end of a long pole. The explosion drives the fumes well into the galleries and nearly always demolishes the whole colony beyond possibility of resurrection. An even more effective remedy than bisulfid of carbon is a solution of cyanide of potassium, one ounce dissolved in a gallon of water. This is poured into the nest until the ground is saturated. A few openings should be previously made into the interior of the nest with a rod. Cyanide of potassium is deadly poison and the vessel used as a container for the solution would best be buried to preclude the possibility of its ever being used by mistake as a container for drink or food for either men or animals.
Whenever necessary.	Various	Snails and slugs.	Soft, slimy, elongated, worm-like creeping creatures without legs, the snails provided with shells, into which they can withdraw their bodies, the slugs without shells. They are provided with two eyes, each at the end of a long, fleshy stalk, and beneath these eye-stalks is a pair of shorter, fleshy feelers. Movement is accomplished by means of a single, flattened, elongated foot on the lower side of the body. Some species of slugs are 2 to 3 inches long. Chiefly nocturnal in their habits.	Have a sort of tongue thickly set with sharp, hard teeth with which they quickly rasp away the surface of vegetable tissue. Often eat away young plants as soon as they appear above ground, the damage resembling that of cutworms or they may cause an apparent failure of germination. Sometimes climb fruit trees and eat holes in fruit.	Use poisoned bran bait as for cutworms; see Spring Manual, p. 78. If small boards or flat stones be scattered through the garden, the slugs will go into hiding beneath them for the day, where they may be found and killed. They can often be trapped in large numbers in this manner. Rings of ground lime or soot around the base of fruit trees will prevent the ascent of the creatures. Cabbage slaw, well chopped and poisoned with arsenic, is sometimes fed to them. Toads are very fond of the smaller species, and also being nocturnal in habit, find and destroy them readily. See Spring Manual, pp. 22-23.

INSECTS OF THE VEGETABLE GARDEN—Continued.

Date for treatment	Crop subject to attack	Name of insect	Description of insect	Character of injury	Remedies to use
Sept., Oct., Nov.	*Asparagus	Common Asparagus Beetle, *Crioceris asparagi.*	See Spring Manual, p. 79.	See Spring Man., p. 79.	Chickens and ducks running through the beds will find and devour many of the beetles. If tney are abundant and feeding in early fall, spray with arsenate of lead, adding a little soap to give adhesiveness and spreading qualities to the spray. As soon as frost begins to appear, or a little earlier, lay a windrow of bark, chips, weeds and hay, intermixed, around the borders of the asparagus bed and soon thereafter remove, so far as possible, the old plants and stubble from the bed, adding them to the trap windrow of trash surrounding the bed. As soon as the beetles are mostly hidden under the trap, set on fire and burn.
Sept., Oct., Nov.	Asparagus	Twelve spotted Asparagus Beetle, *Crioceris 12-punctata.*	See Spring Manual, p. 79.	See Spring Man., p. 79.	Chickens, ducks; and trap as for the preceding species.
Sept., Oct., Nov.	Beans	Common Bean Weevil, *Bruchus obtectus.*	See Spring Manual, page 80.	Eats out the seed and breeds in dried beans, thus passing through several generations between storing time and the spring planting season.	Fumigate seed with bisulfid of carbon before storing. Put in a tight box or other container and for each 100 cu. ft. of space enclosed, distribute into shallow pans, which are set on top of the seed, about one-fourth to one-half pint of liquid bisulfid of carbon; close the container as nearly air-tight as possible and keep closed for a couple of days, then air the seed. The beans will not be injured either for food or for planting. Subjecting the seed to from 120 degrees to 140 degrees Fahr. of heat for a few hours would doubtless accomplish the same purpose and prevent all damage after storing. Collect and burn all remnants of crop left in the field so no beetles will be carried over in waste seed. Turn hogs or poultry in field to pick up seed scattered on the ground.
Sept., Oct.	Beans	Caterpillars of various species, such as corn ear worm, zebra caterpillars, cutworms, etc.	See pp. 72, 161, 61.	Devouring foliage, and often pods or seed in the pods.	Spray or dust with arsenicals, unless pods are to be cooked. Poisoned bran bait for some of them, such as cutworms.
Sept., Oct.	Beans	Leaf Hoppers	See p. 153.	See p. 153.	See p. 153.
Sept., Oct.	Beans	Blister Beetles	See p. 152.	See p. 152.	See p. 152.
Sept., Oct.	Beans	Plant Bugs	See p. 154.	See p. 154.	See p. 154.
Sept., Oct.	Beets	Flea Beetles	See p. 153.	See p. 153.	See p. 153.

*Crops are arranged alphabetically from this point.

INSECTS OF THE VEGETABLE GARDEN—Continued

Date of treatment	Crops subject to attack	Name of insect	Description of insect	Character of injury	Remedies to use
Sept., Oct.	Beets	Blister Beetles	See p. 152.	See p. 152.	See p. 152.
Sept., Oct., Nov.	Beets	Grasshoppers	See p. 58	See p. 58.	See p. 58.
Sept., Oct., Nov.	Beets	Leaf Hoppers	See p. 153.	See p. 153.	See p. 153.
Sept., Oct., Nov.	Beets	Red spider and Mites	See p. 154	See p. 154.	See p. 154.
Sept., Oct., Nov.	Beets	Leaf Miners, *Pegomyia vicina, Chortophila floccosa C. betarum,* etc.	Two-winged flies, the maggots of which grow to be a little more than one-half inch long. The flies are of an olive-ash color or darker, with yellowish or reddish-yellow legs.	Mine out the interior substance of the leaf, causing blotches of various shapes which become dried, shriveled patches after being abandoned by the larvae.	Since the flies breed until very late in the season and upon many such weeds as the pigweed, lambsquarter, etc., collect and destroy all remnants of the beet crop immediately after the harvest and likewise destroy all weeds that are likely to sustain the larvae.
Sept., Oct., Nov.	Beets and many others.	Garden Webworm, *Loxostege similalis.*	Moth, buffy or grayish; larvae are whitish or dusky with black dots; each larva spins a loose web, enclosing more or less of the foliage of the infested plant.	When very young, the larvae gnaw the surface of the leaves, but later eat them full of irregular holes, or else consume them almost wholly, leaving only a blackened, web-covered skeleton.	Keep down all weeds, such as pigweed and purslane, which support the larvae, and also destroy all remnants of the crop left after harvest. Larvae are still feeding in September. Since the moth hibernates, burning over the grassy borders surrounding beet fields in the fall would probably destroy many of them. These moths fly readily to lights, and lantern traps are always more or less useful to catch them. Moths are on the wing in May and June, and again in July; a third brood appears in August and a fourth or hibernating brood comes in September and October.
Soon as crop is harvested.	Cabbage, cauliflower and cruciferous crops.	Cabbage Maggot, *Pegomyia brassicae.*	See Spring Manual, page 81.	See Spring Man., p. 81.	Remove all cabbage stumps after harvest and burn or bury under a few feet of earth. Perform the work immediately after removal of the heads.
Soon as crop is harvested.	Cabbage, cauliflower and cruciferous crops.	Seed-corn Maggot, *Pegomyia fusciceps.*	See Spring Manual, page 80.	See Spring Man., p. 80	Remove all cabbage stumps after harvest and burn or bury under a few feet of earth. Perform the work immediately after removal of the heads.
Soon as crop is harvested.	Cabbage, cauliflower and cruciferous crops.	Cabbage Worms, *Pontia rapae, Pontia protodice, Pontia rapi, Autographa brassicae,* etc.	The three first-named caterpillars are greenish caterpillars, more or less resembling the cabbage leaves on which they feed. The last is a greenish loop worm, striped with whitish lines.	See Spring Man., p. 81.	Remove all cabbage stumps after harvest and burn or bury under a few feet of earth. Perform the work immediately after removal of the heads.
Soon as crop is harvested.	Cabbage, cauliflower and cruciferous crops.	Cabbage Plutella or Diamond-back Moth, *Plutella maculipennis.*	Small caterpillar resting in a white, lace-like cocoon.	Usually feeds on lower surface of leaves, sometimes eats them full of small holes.	Remove all cabbage stumps after harvest and burn or bury under a few feet of earth. Perform the work immediately after removal of the heads. Pupae are attached to old cabbage stalks during the winter.

INSECTS OF THE VEGETABLE GARDEN—Continued.

Date of treatment	Crops subject to attack	Name of insect	Description of insect	Character of injury	Remedies to use
Soon as possible after crop harvest.	Cabbage and various others.	Flea Beetles, several species.	Small beetles of various species, but all with enlarged thighs, which enable them to leap long distances, whence one of the common names—"garden fleas."	See p. 183.	See p. 153. Be specially particular to get rid of a crop remnants and all weeds by uprooting and burning in the fall, so as to reduce the hibernating resorts. Late fall plowing, by turning up the roots of plants on which the larvae feed, and thus exposing the immature stages of the beetles, would apparently be of much assistance.
During fall, after harvest.	Cabbage and other cruciferous crops.	Harlequin Cabbage Bug, *Murgantia histrionica.*	A gayly colored stink bug, often called the "calico back". Striped and spotted with black or dark blue and bright yellow or red.	Saps the leaves of cruciferous crops, causing wilting, withering and dying as if overrun by fire, hence the insect is sometimes called the "fire-bug."	Destroy all cruciferous plants after harvest, or if any be left, use them as trap plants, and spray with pure kerosene whenever the harlequin bug is noticed on them. Piles of weeds and rubbish may be left until late, and when the insects have retreated beneath the shelter, set on fire.
During fall after harvest.	Cabbage and most other garden crops.	False Chinch Bug, (*Nysius augustatus*), Big Eyed Purslane Bug, (*Geocoris bullatus*), Tarnished Plant Bug, (*Lygus pratensis*), and various other small, sucking, true bugs.	Small, sober-colored insects, resembling the Chinch Bug.	Cause wilting and whitening of the plants they sap by means of their sucking beaks.	Keep down weeds which are staple food plants of these bugs, and burn over weedy patches and borders in fall. Trap heaps for shelter, which are burned in early winter, will serve to reduce their numbers.
After cabbage harvest.	Cabbage and cruciferous plants.	Cabbage Aphis, *Aphis brassicae.*	Small, greenish plant louse, dusted over with whitish waxy powder or bloom. Both winged and wingless forms.	Sap the plants and stunt growth and lower quality.	Keep down all volunteer growth and cruciferous weeds during fall, taking care to destroy all remnants of the old crop as soon as it is removed from the ground; very important. Winter is passed in egg-stage on these plants.
Whenever observed.	Carrot, Parsnip and various root and other crops.	Carrot Beetle, *Ligyrus gibbosus.*	A reddish-brown or black beetle, over one-half inch long, resembling a May Beetle. The grub is quite like our ordinary white grubs.	Beetles attack the roots, gnawing into them, eating off the bark or burrowing into the roots or tubers.	Lime scattered through the fields is said to have been of use in some cases. After the crop has been harvested, if the insects still continue in the ground, turn in hogs to pasture the field and devour the insects.
Soon as cucurbit harvest is over.	Cucumbers, squashes, and cucurbits of all kinds.	Striped Cucumber Beetle, *Diabrotica vittata.*	See Spring Manual, page 83.	See Spring Man., p. 83.	Pull up and burn all cucurbit vines after harvest. Clean culture should be extended to destruction of weeds and grassy borders around cucurbit gardens so as to destroy winter hibernating places. Hibernation commences in late September or early October.

INSECTS OF THE VEGETABLE GARDEN—Continued.

Date for treatment	Crops subject to attack	Name of insect	Description of insect	Character of injury	Remedies to use
Soon as cucurbit harvest is over.	Cucumbers, squashes, and cucurbits of all kinds.	Twelve-spotted Cucumber Beetle, *Diabrotica 12-punctata.*	See Spring Manual, page 83.	See Spring Man., p. 83.	Pull up and burn all cucurbit vines after harvest. Clean culture should be extended to destruction of weeds and grassy borders around cucurbit gardens so as to destroy winter hibernating places. Hibernation commences in late September and early October.
Soon as cucurbit harvest is over.	Cucumbers, squashes, and cucurbits of all kinds.	Squash Bug, *Anasa tristis.*	See Spring Manual, page 83.	See Spring Man., p. 83.	Pull up and burn all cucurbit vines after harvest Clean culture should be extended to destruction of weeds and grassy borders around cucurbit gardens so as to destroy winter hibernating places. Hibernation commences in late September and early October.
Soon as cucurbit harvest is over.	Cucumbers, squashes, and cucurbits of all kinds.	Melon Aphis, *Aphis gossypii.*	See Spring Manual, page 83.	See Spring Man., p. 83.	Practice clean culture as directed for preceding species. This louse feeds on many weeds, hence keep these down close.
During bearing period and after harvest.	Cucurbits, especially squash and pumpkin.	Squash Vine Borer, *Melittia satyriniformis.*	A white, grub-like larva, about one inch long, when full grown, found from July until November.	Burrows in the stems, causing them to rot. Usually shows its presence by yellowish powdery frass which it forces out through the stems.	While vines are bearing fruit, cut out the borers by hand. Make a longitudinal cut and tie cloth strip or wind waxed strips around the split stem to hold it together. Instead of cutting the borers out, they may in many cases be killed by injecting bisulfid of carbon into the burrows by means of a spring bottom oil can. Keep the joints, at intervals along the running vines, covered with earth so as to induce new roots to put out at the covered spots and thus safeguard the vine against depending wholly upon one root. After harvest, collect and burn all remnants of plants, and lightly harrow, so as to bring to the surface and expose to the winter weather the cocoons, which are made just beneath the surface of the ground.
Whenever necessary or possible.	Melons and other cucurbits, but partial to the muskmelon.	Melon Worm, *Diaphania hyalinata.*	A greenish-yellow caterpillar, a little over an inch long when full grown.	Feeds on the leaves, when young, and burrows into and devours the fruit when a little older grown. They spin their cocoons in folds in the leaves or under debris on the ground.	Caterpillars feeding on the leaves can be killed by spraying with arsenate of lead before the fruit is half grown, and afterwards by dusting with hellebore or pyrethrum. Destroy all remnants of vines and fruit as soon as harvest is over. Deep fall plowing will prove useful.

INSECTS OF THE VEGETABLE GARDEN—Continued.

Date for treatment	Crops subject to attack	Name of insect	Description of insect	Character of injury	Remedies to use
Whenever necessary or possible.	Cucumbers, melons and cucurbits generally.	Pickle Worm, *Diaphania nitidalis*.	Resembles preceding species in appearance and habits, but is a trifle larger when full grown.	Feeds on the leaves, when young, and burrows into and devours the fruit when a little older grown. They spin their cocoons in folds in the leaves or under debris on the ground.	Caterpillars feeding on the leaves can be killed by spraying with arsenate of lead before the fruit is half grown, and afterwards by dusting with hellebore or pyrethrum. Destroy all remnants of vines and fruit as soon as harvest is over. Deep fall plowing will prove useful.
When necessary.	Cucurbits, tomatoes, lettuce and various crops, especially those grown in greenhouses.	White Fly, *Aleyrodes vaporariorum*.	A minute fly, with two wings which fold over the body in roof-like fashion. The wings and body are powdered over with a milky-white wax. The larvae are oval, flat, scale-like insects, which adhere closely to the undersides of the leaves and are surrounded by a fringe of white waxen rays, extending outward from the circumference.	Sap plants to death or cause wilting and prevent normal development of fruit. The insects excrete large quantities of honey dew, in which sooty, black molds grow.	The larvae may be sprayed with a soap solution, preferably with a potash fish-oil soap, 1 lb. in 4 to 6 gallons of water, or kerosene emulsion diluted with 12 to 15 parts of water. The adults can be killed by fumigating with extract of nicotine. Make a preliminary test, smudging a small number of plants according to directions of manufacturers and if injury to foliage follows, reduce strength of treatment until safe, determining this by continued tests; then apply to whole greenhouse. Several treatments at intervals of ten days or two weeks apart are often necessary to prevent the adults from accumulating and laying their eggs. Fumigation with hydrocyanic acid gas is probably the most satisfactory remedy in greenhouses. Directions for fumigating will be found in Circular 57, Bureau of Entomology, U. S. D. A., and in "Fumigation Methods," by Prof. W. G. Johnson, published by Orange Judd Co., New York City.
Soon as crop is harvested.	Carrot, celery.	Carrot Rust Fly, *Psila rosae*.	Small, footless, white maggots, burrowing in roots of both carrots and celery. Adult fly rather small and slender, dark green, bearing sparse yellow hairs. Head and legs pale yellow, eyes black, length 1-6 inch, wing expanse 3-10 inch.	Perforates roots of stored carrots during winter, making dirty brownish burrows from which the maggots project. The thick part of the root of celery is eaten when the plant is about half grown.	Clean up all remnants of crop after harvest and destroy. Also, after harvest, rake or cultivate celery and carrot fields to a depth sufficient to throw up larvae or pupae to the action of winter frost.

INSECTS OF THE VEGETABLE GARDEN—Continued.

Date for treatment	Crops subject to attack	Name of insect	Description of insect	Character of injury	Remedies to use
September and October.	Celery, parsnip, parsley, and carrot.	Celery Caterpillar, *Papilio polyxenus*.	A large caterpillar, about 2 inches long when full grown, ringed with black and yellowish green bands, and spotted with yellow. The parent insect is the Black Swallow-tail Butterfly, the hind wings ornamented with eye-like spots of yellow and bluish green.	Devours the foliage of the plants it infests.	Handpicking is the safest and surest remedy. Arsenicals should not be used.
Whenever caterpillars are seen. In the greenhouse, there are several generations per year.	Celery, lettuce, parsley, cabbage, beets, cucumber and others.	Celery Leaf Tyer or Greenhouse Leaf Tyer, *Phlyctaenia ferrugalis*.	The larva is green or greenish-yellow with whitish head, marked with purplish dots. It is a little over 1-2 inch long and marked by three longitudinal stripes, a darker green and a lighter one on each side. The moth is yellowish-brown, suffused with a reddish or rusty tinge, and wavy black lines ornament the fore wings.	When young, the caterpillars eat small holes on the under surfaces of the leaves and later skeletonize or devour the whole leaf. Damage is chiefly wrought at night. The pupal nest is made between two leaves tied together, or else in a fold made from the edge of a leaf.	Handpicking of larvae and pupae is reliable and safe. Light traps, over vessels containing water and kerosene, will attract and destroy many of the moths. Arsenicals may be used on some of the field crops and dusting with hellebore or Persian insect powder may prove useful in some cases. Fumigation with hydrocyanic acid gas might be resorted to in the greenhouse.
Whenever observed.	Celery, lettuce, and sugar beet.	Celery Looper, *Autographa simplex*.	A naked, green, looping caterpillar, marked by eight white lines which run longitudinally. The moth also resembles that of the cabbage looper. Fore wings are marked with gray and seal brown, and with a hook-shaped silver mark.	Feeds upon the leaves.	Resort to handpicking, or spray with hellebore or pyrethrum solutions. Other remedies used against the cabbage worms may be used. See p. 157; also Spring Manual page 81.
When observed.	Celery, cruciferous plants and many others.	Zebra Caterpillar, *Mamestra picta*.	When grown, about 3 inches long, velvety black with a red head, red legs and two yellow lines extending along each side, connected together by numerous transverse white cross-lines. The moth is of a rich purple-brown color. White specks are sprinkled over the wings. Also, they are ornamented with white lines.	Devours the leaves.	On celery, handpicking, spraying with hot water, 150 to 170 degrees when it reaches the worms, or with decoction of hellebore or pyrethrum. On crops that are not to be harvested for many weeks, and on plants not intended for food, use arsenical sprays.

INSECTS OF THE VEGETABLE GARDEN—Continued.

Date for treatment	Crops subject to attack	Name of insect	Description of insect	Character of injury	Remedies to use
After celery harvest.	Celery, evergreen trees, etc.	Sulfur-colored Tortrix, *Epagoge sulfurana*	Small, light-green larvae with black mouth and black front feet; head and thorax flesh-colored. The moths are bright sulfur-yellow, netted over with fine, red lines and have larger reddish-brown bands on the primary wings.	They web together the leaves and live within the web, feeding upon nearby leaves outside the web. They pupate within the web.	Clean up and burn, or otherwise destroy all remnants of the crop as soon as the plants are harvested. Some good may be achieved by spraying forcibly with hot water or with decoction of either pyrethrum or of hellebore.
Late fall	Celery, onion.	Cutworms See p. 61. Imported Onion Maggot, *Pegomyia cepetorum.*	Small whitish maggots. Fly resembling a small house fly.	Maggots eat into bulbs and start decay.	Some of these maggots pass the winter in the pupal stage, others in the adult stage. All remnants of the crop should be gathered and destroyed after harvest, and late fall plowing will destroy many of the pupae. Onions stored in bins for winter should be fumigated with bisulfid of carbon or else with hydrocyanic acid gas.
Late fall	Celery, onion.	Common Onion Maggot, *Pegomyia cepparum* Barred-winged Maggot, *Chaetopsis aenea.*	Small whitish maggots. Fly resembling a small house fly. Blackish bars transversely across wings of latter species.	Maggots eat into bulbs and start decay.	Some of these maggots pass the winter in the pupal stage, others in the adult stage. All remnants of the crop should be gathered and destroyed after harvest, and late fall plowing will destroy many of the pupae. Onions stored in bins for winter should be fumigated with bisulfid of carbon or else with hydrocyanic acid gas.
Late fall	Celery, onion.	Onion Thrips, *Thrips tabaci.*	Minute, yellowish-green insects, slender bodied, and very quick in their movements.	Scrape the leaves, especially in the axillary portion, causing a speckled, whitish appearance, inducing early decay and withering of the plant tissues.	The insects hibernate over winter in litter left on the field and in grassy borders and stubble fields nearby. Clean up and destroy all refuse of the crop after harvest and, so far as possible, burn over all hibernating places.
Late fall	Potato	White Grub	See p. 59.		
Late fall	Potato	Wireworms	See p. 58.		
Late fall	Potato	Cutworms	See p. 61.		
Late fall	Potato	Stalk Borer	See p. 62.		
Late fall	Potato	Blister Beetles	See p. 152.		
Late fall	Potato	Flea Beetles	See p. 153.		
Late fall	Potato and other night shade plants.	Colorado Potato Beetle, *Leptinotarsa decemlineata.*	Stout-bodied, oval beetle with 10 black stripes on the wing-covers, the alternating stripes straw-yellow. Larvae reddish, spotted with black.	Devour foliage.	Both adults and pupae hibernate in the earth over winter. Late fall plowing, after freezing has commenced, is of some value, but summer measures are so effective that this plan of control is seldom or never resorted to.

INSECTS OF THE VEGETABLE GARDEN—Continued.

Date for treatment	Crops subject to attack	Name of insect	Description of insect	Character of injury	Remedies to use
Late fall	Potato and Solanaceous weeds.	Potato Stalk Weevil, *Trichobaris trinotata.*	Small, black snout beetle, 1-6 inch long, covered over with gray scales, giving it a uniform, gray appearance. There are three distinct black spots at the base of each wing-cover.	The small, white grubs mine out the interior of the stalks, several larvae sometimes working in a single stalk. The second generation of beetles mature during August and September.	Pull infested vines as soon as they begin to wilt and dry out and burn. As soon as crop is harvested, burn all vines to destroy the beetles within the stalks.
Late fall	Potato or other root crops; also tobacco in the South.	Potato Tuber Worm, *Phthorimea operculella.*	A small caterpillar nearly one-third inch long. Moth resembles a clothes moth, but darker color. Wing expanse about ¾ inch.	Eggs laid on leaves, and caterpillars burrow into stems and from there into tubers. Eggs are also laid on tubers when exposed in the field, and also when they are stored in the bin. The usual proceedings is to mine the outer skin of the tuber, inviting the germs of decay to enter.	Clean up and burn all old vines, tubers and Solanaceous weeds in fall. Let hogs and sheep clean up all remnants of tubers left on the field. Infested potatoes, put in winter storage, should be fumigated as often as necessary with bisulfid of carbon. If not already present, this insect is apt to appear in Ohio.
At harvest	Potato	Potato Scab-gnat, *Epidapus scabiei.*	Very minute, slender maggots, with black heads. Female gnats, wingless, louse-like, but of more sprightly movement than lice. Male a winged, dark-colored midge.	Larvae mine under the skins of the tubers, producing an abnormal development of corky tissue, quite similar to ordinary potato scab. Continue injury on tubers kept in damp storage rooms.	Store in a cool, dry room. Fumigation with bisulfid of carbon at the commencement of storage would probably prevent subsequent damage. Immersing the tubers in corrosive sublimate solution or in diluted formaldehyde, as for ordinary scab, would probably destroy most of them. Sort out, so far as possible, the affected tubers, and feed to live stock. Treat the remainder as recommended and store.
In late fall	Potato	Mole Cricket, *Gryllotalpa borealis.*	An elongated, underground cricket, with front feet expanded like the flippers of a mole, for digging.	Tunnels back and forth through the tubers. These insects are most common on low, black, muck soils.	Perhaps the European practice of digging pits and filling with horse manure will succeed here as well as there. The heat of the pits attracts the insects and just outside are buried poisoned baits, such as potato tubers.
In late fall	Radish	Cabbage or Radish Maggot, *Pegomyia brassicae.*	See p. 157; also Spring Manual, p. 81.	See p. 157; also Spring Manual, p. 81.	See p. 157; also Spring Manual, p. 81.

INSECTS OF THE VEGETABLE GARDFN—Concluded.

Date for treatment	Crops subject to attack	Name of insect	Description of insect	Character of injury	Remedies to use
Late fall	Rhubarb	Rhubarb Curculio, *Lixus concavus.*	A slender snout-beetle, over one-half inch long, dark gray in color, and covered with a rusty or clay-red powder.	The grub tunnels in the stalk and the adults eat punctures into the stalks to obtain food.	The beetles may be found resting on the leaves in late fall. They are very sluggish and can be collected by hand. Remove old leaves regularly and destroy. Also destroy all plants of dock growing nearby, since the beetles also feed on these.
Late fall	Rhubarb	Rhubarb Flea Beetles	See p. 153.		
Late fall	Rhubarb	Stalk Borer	See p. 62.		
Late fall	Sweet Corn	Practically the same as corn insects.	See p. 71.		
Late fall	Sweet Potato	Cutworms	See p. 61.		
Late fall	Sweet Potato	Flea Beetles	See p. 153.		
Late fall	Sweet Potato	Garden Webworm	See p. 157.		
Late fall	Squash	Same pests as cucumber and other cucurbits.	See p. 160.		
Late fall	Tomato	Tomato Worm or Tobacco Worm, *Phlegethontius quinquemaculata.*	See p. 83.		
Late fall	Tomato	Southern Tobacco Worm, *Phlegethontius sexta.*	See p. 83.		
Late fall	Tomato	Tomato Fruit Worm or Corn Ear Worm, *Heliothis obsoleta.*	See p. 72.		Fall plow land intended for tomatoes the following summer. Hand-pick fruits containing worms and feed to poultry or cook to destroy the worms.

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Bold face type refers to headings and important paragraphs.